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Naval Architects' Meeting

The preliminary programme printed elsewhere in this issue of the annual meeting of the Society of Naval Architects and Marine Engineers, which will be held in the Engineering Societies' Building, New York City, December 10 and 11, indicates that a wide range of subjects will be brought up for discussion. Two excellent papers giving the results obtained from model experiments show the effect on resistance of various changes of form of a ship's hull, while other important subjects include electric propulsion, oil engines and the protection of vessels against disaster by collision and fire. In view of the fact that this meeting brings together a large number of the men best equipped to discuss matters relating to shipping and shipbuilding, it is to be hoped that at least a part of the meeting will be devoted to a discussion of the question of upbuilding the American merchant marine in foreign trade. Never before has the need for action in this direction been more urgent, and the opportunity should not be lost for formulating the most feasible plans for aiding this movement.

Shallow Draft Boats

In devoting this issue almost wholly to the subject of shallow-draft boats, we wish to emphasize again a point which we have brought out many times regarding the development of inland navigation. The prime requisites for successful inland navigation are improved waterways, efficient floating equipment and adequate terminal facilities. Much has already been done by the Government in improving the navigable rivers of the United States, and, with the completion of the projects which are now in hand for establishing and maintaining channels of a uniform depth on such rivers as the Mississippi, Ohio and Missouri, one of the chief obstacles to the growth of inland navigation will have been overcome. A number of changes are also being made in the design of river boats by the adoption of improved methods of propulsion in towboats and the development of self-propelled barges, so that the cost of transportation on inland waters will probably be brought to a favorable competitive basis with railway transportation. The third requirement, however, that of adequate terminals along rivers and inland waters, has progressed very little, if at all, in most cases. For an adequate terminal, besides economical means for handling freight, the greatest necessity is co-operation with railway, steamship and other transportation companies for transshipment of freight.

Three Cash Prizes

Cash prizes of $15, $10 and $5 are hereby offered for the three best letters sent by marine engineers to the Contest Editor of this journal before January 1, 1915. In addition to the prizes, the winning letters will be paid for at regular space rates when published in the magazine, and all other letters submitted in the contest which do not receive prizes, but which are accepted for publication, will also be paid for at regular space rates. The letters should give some idea or experience gained by the engineer either in his every-day work in the engine room on board ship, or in the building of marine machinery. The field is a wide one, as any subject may be chosen which relates to the design, construction or operation of marine machinery, including boilers, engines, condensers, pumps, piping, evaporators, distillers, winches, steering engines, electrical, refrigerating, heating or ventilating apparatus, and the like. Any reader may send in as many letters as he pleases, and there are no restrictions as to the length of the letter or the subject discussed, although each letter should preferably be short and confined to a single subject.

A Special Naval Reserve

In the Administration shipping bill, which will probably be one of the first measures taken up in the next session of Congress, there is a provision giving to the masters, watch officers and seamen employed on the vessels provided for in the measure, who are citizens of the United States, the privilege of enlisting and being enrolled in a special naval reserve. While so enrolled and employed they may receive such pay and relative rank as the President of the United States may prescribe. Whatever disposition may be made of the shipping bill, we are heartily in favor of the establishment of a special naval reserve in which the officers and men shall receive suitable pay and rank from the government in return for their services. If such a measure were made applicable to all foreign-going ships in the American merchant marine, it would not be long before a strong and efficient body of men, thoroughly experienced in the handling of ocean-going vessels, would be available as a most valuable adjunct to the United States navy. At the same time, the payment of the comparatively small sums of money for this pur-

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pose by the government would enable American ship owners to place more ships in the foreign-carrying trade, and as a consequence a large part of the immense sums that are now paid annually to foreign ship owners for carrying overseas freight would be kept at home. Under the present conditions it is freely admitted that government aid of some form is practically a necessity in order to overcome the difference in the cost of operation of American and foreign ships; and in considering ways and means of accomplishing this, the proposed scheme of establishing a special naval reserve should be given careful consideration.

Registry of Foreign-Built Vessels

Up to October 24, seventy-eight foreign-built vessels, aggregating 272,548 gross tons, were admitted to American registry under the provisions of the amendment to the Panama Canal act, which became a law on August 18. Sixty-seven of these vessels, aggregating 240,257 gross tons, were formerly under British registry, seven, aggregating 26,069 gross tons, were formerly under German registry, and four of 6,222 gross tons were formerly under Belgian registry. With an increase of over a quarter of a million tons in the short space of two months, the American merchant marine is rapidly approaching an important position in the foreign-carrying trade, and it is not unlikely that in the near future English capital will be attracted to American shipping, thereby further strengthening its present position.

The Western River Steamboat

The type of vessel known the world over as the western river steamboat was developed to meet the natural conditions on the large western rivers of the United States, and for this reason it is a distinct departure from ordinary steam vessels. On account of low water, the boats plying on the western rivers are frequently aground or are obliged to force their way over sand bars or reefs. In the early days of river navigation, before river improvements were begun by the government, it was practically an everyday matter to encounter in the river such obstacles, and for this reason it was necessary to build a boat which could with its own power cut its way or lift itself over shallow places. Moreover, on account of the sharp bends and changing channels, the boats were required to maneuver constantly, and full backing power was a necessity.

A careful study of the characteristics of the typical western river steamboat will show at once its many advantages for navigation under such conditions. The shape of hull usually follows a more or less standard design, the weights being so distributed that the draft at the stern of the boat is practically the same under all conditions of loading. This is done in order to insure uniform immersion of the stern wheel. Steel is used almost universally now for the construction of the hulls, as it has proved more economical than wood, in spite of the increased cost of a steel boat over a wooden boat. The type of power plant used has been accused from a good many quarters of being inefficient and wasteful; and while to some extent these accusations are true, for the most part the typical western river steamboat is operated with a fair amount of efficiency. The boilers are of a type specially adapted to the river conditions, as the feed water is usually very muddy and contains many impurities; high steam pressures are carried and numerous repairs are needed on the boilers owing chiefly to burned plates or leakage. The engines are of heavy construction, with massive, slow-moving parts, and, as a rule, seldom need repairs. The wear on the moving parts is very slight, and although the stern wheels are constantly striking obstructions, little damage is done to any part except the buckets of the wheels themselves.

Two Important Bills Introduced in Congress

In line with the suggestions made in our last issue urging the enactment of legislation to increase the security of marine mortgages, Judge J. W. Alexander, chairman of the House Committee on Merchant Marine and Fisheries, introduced in the House on October 20 two bills to amend the maritime laws of the United States so as to protect ship owners in the sale or transfer of vessels. The first of these reads as follows:

"That section 4196 of the Revised Statutes of the United States be amended so as to read as follows:

"Sec. 4196. All bills of sale of vessels registered or enrolled, shall set forth the part of the vessel owned by each party selling, and the part conveyed to each party purchasing.

"Where any vessel, registered or enrolled, is subject to any encumbrance, recorded as provided for in Section 4193 of the Revised Statutes of the United States, the existence of such encumbrance shall be noted upon the face of each registry of enrollment and on all abstracts or copies thereof, and when so noted the same shall be conclusively presumed to be notice to any subsequent purchaser; but the failure so to note any such encumbrance shall in no wise diminish the binding force thereof."

The second bill reads as follows:

"That no vessel, registered or enrolled as a vessel of the United States, shall be sold or transferred, in whole or in part, to a subject or citizen of any foreign prince or State, so long as there exists against any such vessel any mortgage, hypothecation or lien recorded as provided by law; and in the event of any such sale, said vessel, together with her tackle, apparel and furnishings, shall be forfeited to the United States, without prejudice, however, to any such encumbrance.

"The person entitled to the benefit of any such encumbrance may file a petition stating his interest in the course of any proceeding for forfeiture, whereupon such order shall be made as will preserve the right of the encum-

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brancer in the proceeds of the sale of the vessel thereunder."

These bills should speedily be enacted into law, so that investment in overseas shipping and the transfer of foreign ships to American registry will be thoroughly protected from unnecessary financial losses.

River Towboats in Europe

The report on experimental towboats prepared by a special board of army engineers, which is reviewed elsewhere in this issue, is one of the most valuable documents which has been compiled on the subject of river towboats in recent years, and will well repay a careful study by those engaged in river navigation. The investigation covers many different types of river towboats, barges and methods of towing. The principal navigable rivers of Europe were visited and observations made of the methods of towing and types of boats used in those places.

The prevailing type of towboat on European rivers was found to be the side wheel steamer with compound or triple expansion condensing engines with the two paddle wheels mounted on a single shaft. The stern-wheel towboat, which is the prevailing type in use on the western rivers of the United States, is used only to a limited extent on the large German rivers. The main objection to its use seems to be the liability of the wheel to damage when the boats were swung around in contact with the banks of the river, which for the most part are rocky. On the lower reaches of the German rivers a number of propeller towboats, principally of the twin screw type, are used. On the Rhine, tunnel screw towboats are used in which the screw is only about 66 percent submerged when not in motion, although after starting ahead the tunnel is completely filled with water. Very little backing by the towboat is required, however, so that ample power is developed for this purpose by the submerged portion of the wheel. Most of the barges on the German rivers are of ship-shape models with rather blunt bows and fairly fine lines aft.

Contrary to the conditions on the western rivers of the United States, where most of the towing is down-stream, the preponderance of tonnage handled on the European rivers is up-stream traffic. The methods of towing on different rivers are practically the same. In general, the towboat leads and the barges follow, either single or two or more abreast. Occasionally a barge is placed on each side of the towboat, although this formation is not widely used. The size of the individual tow is always larger along the lower rivers, gradually decreasing in size on the upper reaches.

In the upper parts of some of the German rivers, where rapids are frequent and the current is swift, a novel system of towing is in common use in which chain towboats are used. The chain is laid in the bottom of the river and the towboat is built with both the bow and stern sloping down nearly to the water level. The chain is led in over the bow through a series of fair leads to a power-driven wildcat amidships and then out over the stern in a similar manner. On the Rhone, where even swifter rapids are found, a similar type of towboat is used, with the exception that a wire rope is substituted for the chain, and instead of passing the rope in at the bow over a wildcat or drum and out again at the stern, the wire rope belongs to the individual boat and is wound up and retained on the drum on the up-stream trip and paid out again on the down-stream trip. Each boat carries from 8 to 10 miles of rope, the length of the rope limiting the distance which any boat can cover. The three principal objections to the ordinary chain towboat are the frequent breaking of the chain, causing expensive delays, the difficulty of one tow passing another, and the inefficiency and helplessness of the boat except when attached to the chain. Such boats are still being built, however, although in decreasing numbers, and eventually they will probably be replaced by more powerful modern self-propelled towboats.

Another river in Europe on which is found a distinctive type of towboat is the Volga, in Russia, where Diesel-engined, side-wheel towboats are used to a considerable extent with excellent results. In general appearance these boats resemble the side-wheel steam towboats on the Elbe and Rhine. The engines are of the slow speed, heavy duty type, set athwartships and connected to the paddle shaft by reduction gearing. The fuel consumption averages about .5 pound per horsepower and the weight about 100 pounds per brake horsepower. The saving in weight by such installations on large river boats enables a material reduction in the draft of the boat, while the cheapness of the fuel and the reduction in the operating force as compared with steamboats reduce the cost of operation to a minimum.

In many of the harbors on the German rivers the facilities for loading cargo into and out of barges have been developed to a very high state of efficiency. In ports like Rotterdam, where the requirements are largely for the transfer of freight from a barge to a ship, floating equipment, such as floating cranes, derricks, grain elevators, coal handlers, etc., is used extensively. Special equipment is provided in many places for handling special cargoes, such as coal, ore or grain, while for handling miscellaneous freight a very complete equipment of traveling cranes is generally used.

It is interesting to note that along the lower 355 miles of the river Rhine there were in 1907 sixty-two harbors with a total water area of 2,200 acres, a wharf frontage of 150,000 yards, storehouses to the number of about 400, and handling machinery amounting to 500 cranes, 53 coal tips and 54 elevators, while on the Mississippi, Missouri, Ohio system in the United States, with 3,700 miles of navigable waterways, there is not a single harbor worthy of the name. From the experience gained in investigating conditions abroad, however, the army engineers have come to the conclusion that it is undesirable to install any but the simplest form of cargo-handling appliances on river boats or barges, and that to handle cargoes economically there should be provided efficient terminal facilities.

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The Augusta-Savannah Barge Line

Producer Gas Steel Barges Built for Service on the Savannah River—Terminal Facilities at Augusta

BY R. E. ANDERSON, C. E.*

The Augusta-Savannah Navigation Company, of Augusta, Ga., is having constructed for service on the Savannah River two shallow-draft, self-propelled steel barges of the tunnel-stern type, equipped with producer gas engines.

For a great many years Augusta has profited greatly by the traffic conducted on the river, the city being at the head of navigation. Under the United States Army engineers the river has been improved by dredging and by bank protection, and a channel 80 feet wide, with a depth of 5 feet at summer low water, is maintained by the Government. Various companies have operated boats upon the river in competition with the railroads, with the result that Augusta has enjoyed the most favorable freight rates of any inland city in the Southeast.

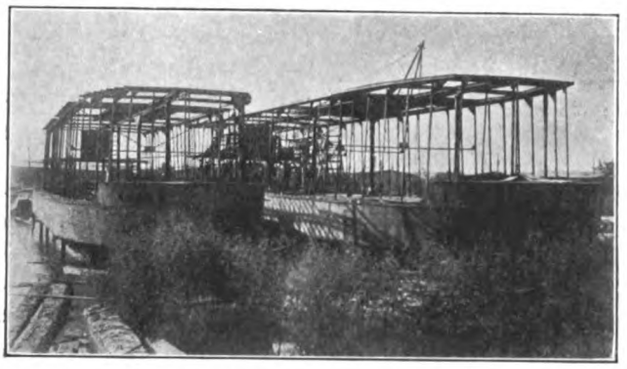

Fig. 1.—Augusta Barges under Construction

For various reasons, however, chiefly on account of neglect and inefficient management, the river route has recently been falling into disfavor with shippers, and river traffic has declined to such an extent that withdrawal of the Government appropriations was seriously contemplated. In order to restore the river traffic, the competition of which with the railroads has been largely responsible for the low freight rates enjoyed by shippers at Augusta, the business men of Augusta have united in a movement which has resulted in the organization of the Augusta-Savannah Navigation Company, to carry on service on the Savannah River. The organization is based on an adequate plan of finance under responsible management. Modern self-propelled barges are being built capable of maintaining schedules and of obtaining favorable insurance rates. Complete traffic arrangements have been made with connecting coastwise steamship lines, and up-to-date terminal facilities are to be provided at Augusta, insuring low stevedoring costs and providing trackage facilities connecting with various railroads entering Augusta. The design of the floating equipment and the Augusta terminal has been worked out by R. C. Wilson, of New Orleans.

Hull Construction

After careful investigation, a vessel of about 300 tons carrying capacity was decided upon, of all-steel construction, with producer-gas propelling machinery. The general dimensions are as follows:

Length	150 feet
Depth	5 "
Draft, loaded	4 "
Breadth	30 "
Cargo capacity, about	300 gross tons

The form is of the usual flat-bottom type, with easy lines aft in way of the tunnels, and with slightly raking stem and "flat-iron" bow, a form of entrance which was adopted in preference to a spoon bow, on account of floating logs and snags.

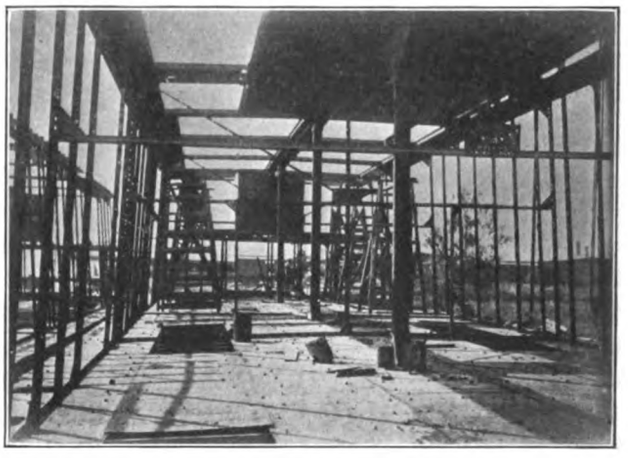

Fig. 2.—Main Deck of Barge, Looking Aft

The hull is built entirely of medium steel. The side and bottom plating is ¼ inch thick, with lapped seams and butts, and the deck plating is 3/16 inch thick, also with lapped seams and butts. The bilge is square, with a heavy bilge angle on the outside.

The frame spacing is 24 inches, except in the forecastle, where it is reduced to 18 inches. The frames consist of channel-bar floors, to which the vertical angle-bar side frames are bracketed. The floor channels are 5 inches by 6.5 pounds, except at the ends, where they are reduced to 4 inches by 5.25 pounds, and the side frames are 3 inches by 2 inches by ¼ inch, except at the stern, where they are reduced to 2 inches by 2 inches by ¼ inch. The deck beams are 4-inch by 5.25-pound channels, one on every frame. Abaft the cargo house the deck beams are suitably reduced.

Three heavily constructed latticed girders provide longitudinal strength as well as local stiffening. These girders consist of 6-inch by 8-pound channels, fitted on top of the floors and under the deck beams, connected by vertical and diagonal latticing of 3-inch by 3-inch by ¼-inch and 3-inch by 3-inch by ⅜-inch angles. These girders merge into the engine foundations and provide a peculiarly rigid construction.

On the outside of the hull two fender-wales are fitted, consisting of yellow-pine timbers secured to the hull by

* Member of American Society of Naval Architects and Marine Engineers.

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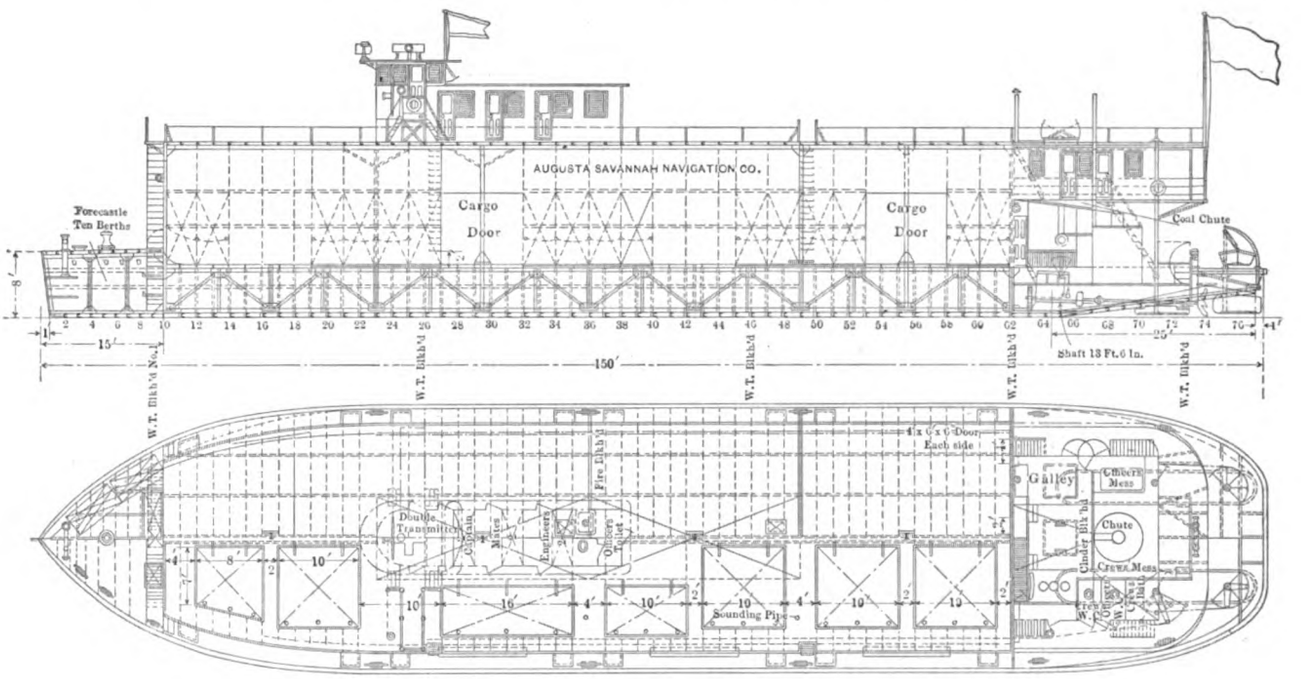

Fig. 3.—Inboard Profile, Half Plan and Half Section of Savannah Barge

double angle bars, and thus forming efficient side stringers.

Forward, a raised forecastle provides crew space, and closely spaced air-ports, with the large access hatch, will permit thorough ventilation. Access to the hold compartments is provided by bolted-plate hatches, as these compartments will not be used for cargo. Heavy towing and mooring bitts are fitted both forward and aft, and an American Engineering Company's capstan is mounted on the forecastle deck.

Each vessel will have four partly balanced rudders, two in each tunnel. Two large rudders are located just abaft the propellers, and two smaller rudders, intended principally to give control in backing, are located forward of the propellers. All four rudder stocks are linked together, and couplings are provided in the rudder stocks to permit a damaged rudder to be quickly replaced. Each boat will carry two spare rudders, one of each type.

STEEL CARGO HOUSE

An interesting feature of the boats is the steel cargo house. This is 104 feet long, 26 feet wide and 15 feet high, with an athwartship bulkhead, or fire-wall, dividing it into two compartments. The framing consists of vertical steel angle bars, and a series of horizontal angle-bar purlines, to which the covering of heavy corrugated

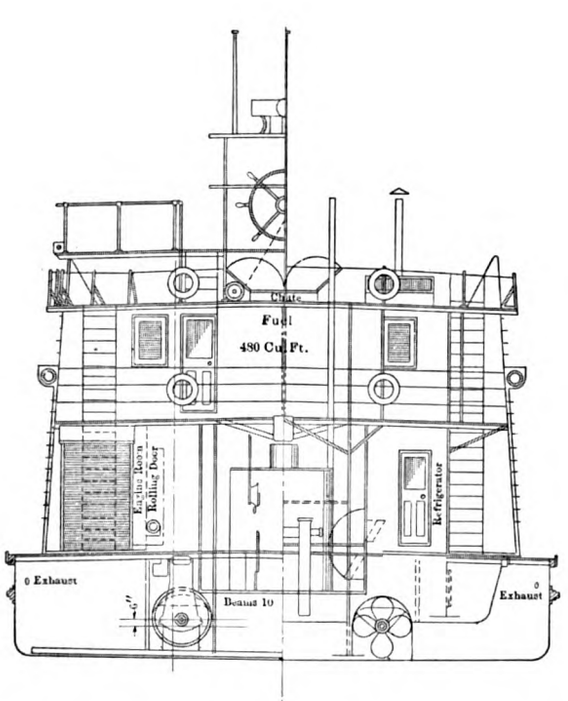

Fig. 4.—Section Through Machinery Space, Looking Forward

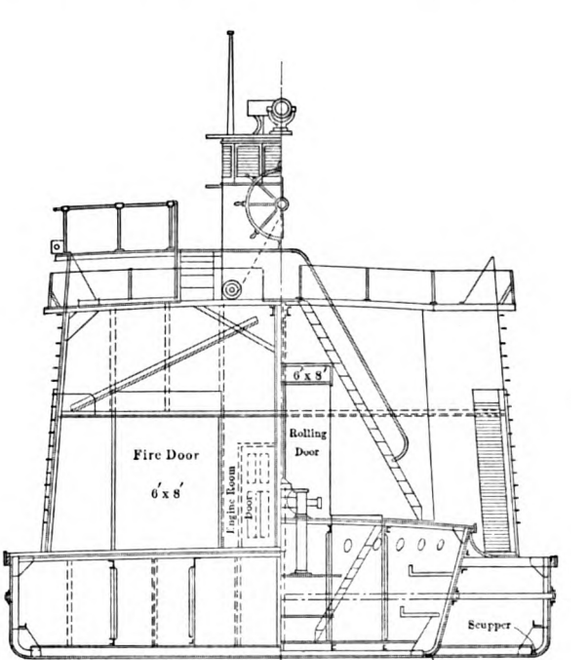

Fig. 5.—Section Through Cargo House, Looking Aft

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galvanized metal is attached. Two large metal-covered cargo doors in each side of the house give access for stevedoring, and metal-covered doors are also provided in the ends of the house and in the fire-wall. The deck over the house is framed with 4-inch channel beams spaced 24 inches, and a double girder of 6-inch channels supports this deck on the center-line, this girder being upheld by the framing of the bulkheads and by bracketed pillars of 8-inch I-beams. The upper deck is plated with 3/16-inch steel, and practically the entire deck can be opened up for handling cargo over-all, by a series of large hatches with hinged-plate covers, also of 3/16-inch steel. An idea of the capacity of the cargo house may be obtained from the fact that it is capable of holding more than 1,200 bales of uncompressed cotton.

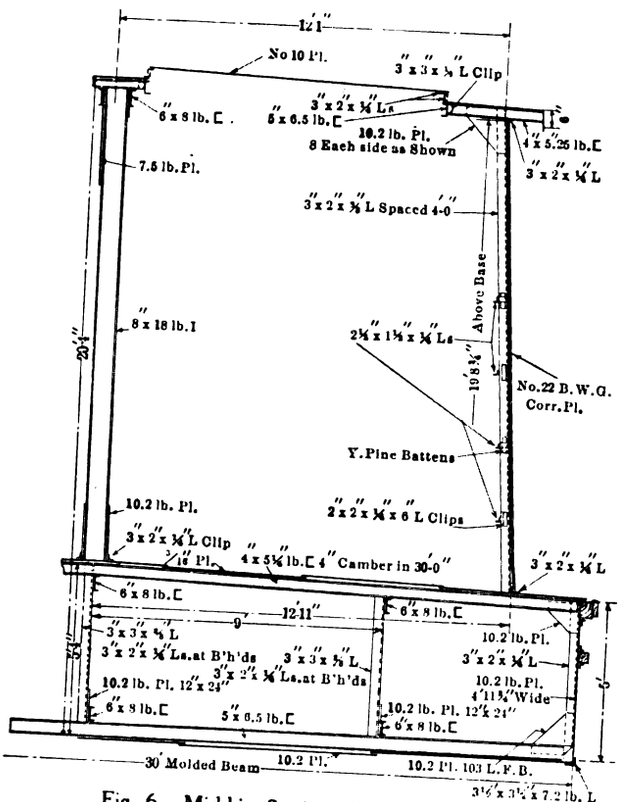
12'1"
No 10 Pl.
3" x 3" x ⅜" L Clip
6" x 8 lb. C
3" x 2" x ¼" Ls
5" x 6.5 lb. C
10.2 lb. Pl.
8 Each side as Shown
4" x 5.25 lb. C
7.5 lb. Pl.
3" x 2" x ¼" L
3" x 2" x ¼" L Spaced 4-0"
Above Base
8" x 18 lb. I
2½" x 1½" x ¼" Ls
No.22 B.W.G. Corr. Pl.
Y. Pine Battens
10.2 lb. Pl.
2" x 2" x ¼" x 6" L Clips
3" x 2" x ¼" L Clip
4" x 5¼ lb. C
4" Camber in 30-0"
3" x 2" x ¼" L
6" x 8 lb. C
12'11"
9'
3" x 3" x ⅜" L
3" x 2" x ¼" Ls at B'h'ds
3" x 3" x ⅜" L
10.2 lb. Pl. 12" x 24"
5" x 6.5 lb. C
30' Molded Beam
10.2 Pl.
10.2 Pl. 103 L.F.B.
3½" x 3½" x 7.2 lb. L

Fig. 6.—Midship Section, Showing Scantlings

The pilot house and a small Texas containing three staterooms, with officers' shower, lavatory and toilet space, surmount the cargo house, and, like it, are framed with steel and are housed in with corrugated galvanized metal. In conformity with the general fireproof design of the vessel, the doors, window frames, etc., of the quarters are of metal or metal-covered construction.

Abaft the cargo house are found the engine and producer rooms and coal bunker, engineers' and crew's toilets, crew's bath, the refrigerator and pantry, galley and messrooms, all these enclosures being entirely of metal construction.

Propelling Machinery

Each boat is propelled by twin screws driven by two 75-horsepower, three-cylinder Wolverine gas engines, furnished by the Wolverine Motor Works, of Bridgeport, Conn. The engines are of the most modern type, water cooled and with compressed air for starting, and the control and reverse levers are so arranged that both engines can be controlled from a central grating. The tail shaft is encased in a watertight tube so arranged as to provide forced lubrication for the stern and strut bearings. The propellers are three-bladed, of the built-up type, with provision for some adjustment of pitch, and each boat carries a pair of spare propellers, convenient hatches in the tunnels and deck permitting the ready replacement of an injured propeller.

The engines will be supplied with gas by a Galusha suction gas producer furnished by A. L. Galusha & Co., of Boston, Mass. Anthracite pea coal is used, and the arrangement provides a coal bunker above the engine room, from which the producer can be fired with a minimum of effort.

Fire Protection

An unusually large and powerful fire and bilge pump is installed in the engine room, with the object of providing fire protection very much above the average. Each pump is of 300 gallons capacity, Worthington, Class A, two-stage, and is mounted on a sliding base, permitting it to be driven off the port main engine by a friction drive, or off the starboard engine by a belt drive. The pump suction is taken from an athwartship supply main with intake through both sides of the vessel, and lever-operated gate valves are fitted in this cross pipe so that should the vessel be lying against the river bank the valve on that side can be closed to prevent sand being drawn in, the intake on the opposite side being of ample size for the pump suction. The engine circulation and producer pumps take their suctions from this same cross pipe, thus simplifying the outboard connections and giving all pumps the protection of the double gate valves.

The fire pump supplies a double main extending down each side of the cargo house, with fire plugs and attached hose so disposed that any point in the vessel can be reached with two streams at 100 pounds pressure from 50-foot lengths of hose with 1-inch nozzles, which is just double the requirements of the steamboat inspection laws. In addition, each boat will carry a full outfit of fire buckets and chemical fire extinguishers, and on the upper deck a portable chemical fire engine, with a 50-gallon tank and 50 feet of hose, will be carried on chocks, ready for instant service to any hatch or for landing in case of a wharf fire. This unusually elaborate fire-fighting equipment will secure low insurance rates on the cargo, and, what is even more important, will render anything but a small blaze in the cargo practically impossible, the boats themselves being non-inflammable.

The electric plant includes a 10-kilowatt generator, driven from the starboard main engine, a storage battery of ample capacity, with automatic charging switch, a powerful searchlight and an electric whistle, with the usual lighting circuits, outlets for portholes, etc. All wiring will be run in metal conduits and will conform to underwriters' rules.

The plumbing is of higher class than is ordinarily to be found on river boats, and includes shower baths for officers and crew. The fresh-water supply is carried in a large tank in the hold, and is distributed by means of an air pressure of 30 pounds, derived from the engine compressed-air tanks. A hot-water heating system is provided for heating the pilot house, messrooms and staterooms, with an American Ideal hot-water heater located in the engine room.

Cargo-Handling Machinery

For handling cargo at the Augusta terminal, main reliance is placed on the terminal appliances, but for use at other landings and also for auxiliary use at Augusta, each vessel is equipped with two power-driven cargo winches furnished by the National Hoisting Engine Company, of Harrison, N. J., through the Austin Machinery

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Company, of Atlanta. These winches are mounted on the upper deck, forward and aft, and are geared to a longitudinal shaft carried just under the deck, which in turn is belt driven from the port main engine. Each boat carries two portable cargo derricks of a special type not unlike the United States Navy coaling booms, and of 2,000 pounds capacity each. Convenient step fittings are provided for using these derricks to plumb the hatches on either side of the vessel.

KNOCK-DOWN CONSTRUCTION

The contract for the two boats was awarded on May 1 to the Racine-Truscott Shell Lake Boat Company. The steel work was fabricated at that company's shipyard in Muskegon, Mich., in record time, the boats being loaded on cars consigned to Savannah by August 1, after having been erected and bolted together and then knocked down at Muskegon.

The work of erection at Savannah has progressed rapidly, and it is expected that the trials will be run early in December.

AUGUSTA TERMINAL

In the design of the Augusta terminal, which is being built by the city primarily for the use of the new Navigation Company, every effort has been made to provide wharfage facilities which would enable the freight to be handled rapidly, safely and economically, it being realized that in low stevedoring costs lay an all-important element of success. The problem was rendered somewhat difficult by the fact that the flood stage of the river had to be taken into account as a controlling feature of the design, and to insure safety to the freight and freedom from interference with the operation of the boats and terminal, the wharf deck and warehouse floor were put several feet above the highest recorded water level, or about 30 feet above the ordinary surface of the river.

To minimize the fire risk, the wharf deck and warehouse floor are reinforced concrete, and the warehouse is carried on concrete piles, the remainder of the structure being supported by heavy wooden piling treated with a preservative and so arranged that the piles may be replaced eventually by concrete as renewal becomes necessary. The wharf has a total length of 300 feet along the river, and the warehouse, of corrugated metal on a steel frame, is 200 feet by 60 feet, with a height under the eaves of 20 feet.

Between the warehouse and the string piece of the wharf an electrically operated locomotive "Brownhoist" crane will run on an 8-foot track parallel to the river, and will provide the principal means for overcoming the 30-foot lift made necessary by the height of the wharf above the ordinary stage of the river. This hoist will operate directly through the large cargo hatches in the upper deck of the boats, and will deposit on the wharf or on the electric storage-battery trucks, of which two will be provided.

As a further provision for overcoming the 30-foot lift, arrangements are being perfected for running the electric trucks down to the boats by means of either inclined or vertical elevators, so arranged that all stages of the river will be provided for. At ordinary stages of the river a paved wagonway will also be available for direct teaming to and from the boats.

For rapid loading, both the crane and the electric trucks will be available, and in addition there will be package chutes for use with all kinds of freight for which this method is suitable, including baled goods, cased goods, etc.

On the land side of the warehouse will be laid the siding connecting with all the railways entering Augusta, and making it possible to switch a car to any warehouse or factory having track connections. The lay-out provides for a three-track switching yard, although only one track will be laid at first. A short spur will be run out onto the wharf, where it can be reached by the locomotive crane, making it possible to load a flat car directly from the boats, and under this spur a coal storage bin can be provided for producer coal, when needed, so arranged that the boats can be coaled by gravity, the coal being dumped from the cars into the bin and from the bin into the bunkers without any handling.

With the arrangements described it will be possible to handle freight with great rapidity, both in discharging and in loading, with correspondingly low stevedoring costs and with the further advantages of quick delivery to consignees and short tie-up periods for the boats.

Twin Tandem Screw Light Draft Steamers for Russia

Early in July Messrs. John I. Thornycroft & Co., Ltd., shipped from Southampton two interesting shallow-draft boats for the Department of Ways and Communications to Russia, the order being completed within ten weeks from its receipt. Fig. 1 shows the vessels under construction in Messrs. Thornycroft's yard. They were subsequently dismantled and shipped for re-erection at Tiumen, on a tributary of the river Ob, Siberia. Their dimensions are:

Fig. 1

Length on waterline .....90 feet
Beam molded .....15 feet
Depth ..... 5 feet
Draft in service condition.... 2 feet 1½ inches

The hull is built with twin-tandem screw tunnels, and is of mild steel plates and angles of light scantlings, and divided into four watertight compartments. The fore peak is fitted as a chain locker, and abaft is placed under a coach roof the crew space, with berths for four men.

The amidships compartment contains the machinery, consisting of two sets of compound-jet condensing engines, giving a total of 130 horsepower at 280 revolutions. The cylinders are 6¾ and 13½ inches diameter, with 8½ inches stroke.

Steam is supplied by a navy type boiler, 5 feet 8 inches diameter by 12 feet 4 inches long, burning coal and working under natural draft at a pressure of 140 pounds per square inch.

The after compartment is fitted as a saloon, with coach roof over, and contains sofa berths for six officials. The after peak is arranged as a small hold. The vessels are steered by a hand-steering gear placed on the coach roof forward, and connected to a large area balanced rudder. A towing hook is fitted on the casing aft, and a small hand-windlass forward for working the cables.

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Review of United States Army Engineers' Report on Experimental Towboats

BY H. MC L. HARDING*

In accordance with the River and Harbor Act of June 25, 1910. an appropriation of $500,000 (£102,500) was made by Congress for the construction of two towboats, together with a complement of suitable barges and necessary loading and unloading facilities, such as are required on the Mississippi River. The appropriation also covered an extensive investigation of the types of boats in use for similar purposes on non-tidal rivers in the United States and in foreign countries.

The Commission of United States Army Engineers appointed to carry out this investigation, and make the necessary experiments, has now completed its work, and the results have been printed by the Government. The work required four years for completion, and included a trip abroad for the investigation of river navigation in Europe. The printed report discusses the various methods of river transportation, experiments upon model towboats and barges, experiments on paddle wheels, and also a consideration of cargo-handling appliances. No report has been issued by the Federal Government for many years which has such a direct value as this report, and Colonel Lansing H. Beach, Lieutenant Colonel H. C. Newcomer, Lieutenant Colonel Charles L. Potter and Lieutenant Colonel C. Keller are to be congratulated and thanked for the valuable information they have collected and so forcibly presented.

The committee, which conducted the investigation in Europe, brought back many new facts based upon keen and practical observation of types of river boats and methods of operation. The committee visited previously unreported fields and described the tugs and barges on such rivers as the Molden, Danube and Saone, as well as the craft on the rivers of Germany, Belgium and Holland. Data were also collected at European shipbuilding plants regarding the construction and operation of shallow-draft boats for use on the swift rivers of Africa and India.

The report answers fully the following questions, which so often occur to those who are engaged in or are about to engage in river transportation. The results are confirmed by the most careful studies and by experiments by experts.

1. What should be the design of the barge, its length, width, material and capacity?

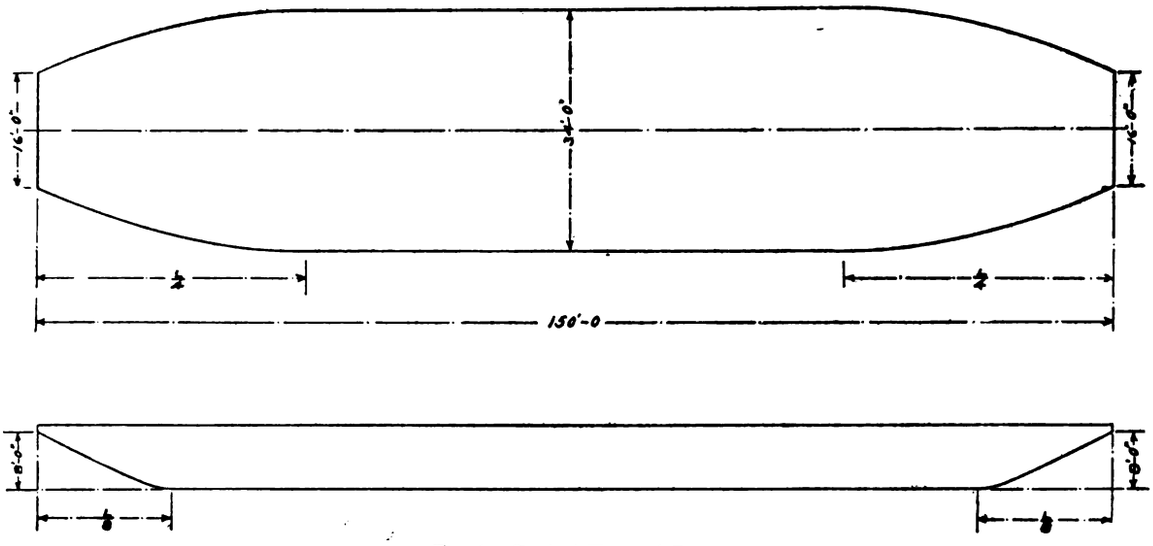

Fig. 1.—Decked Type of Barge

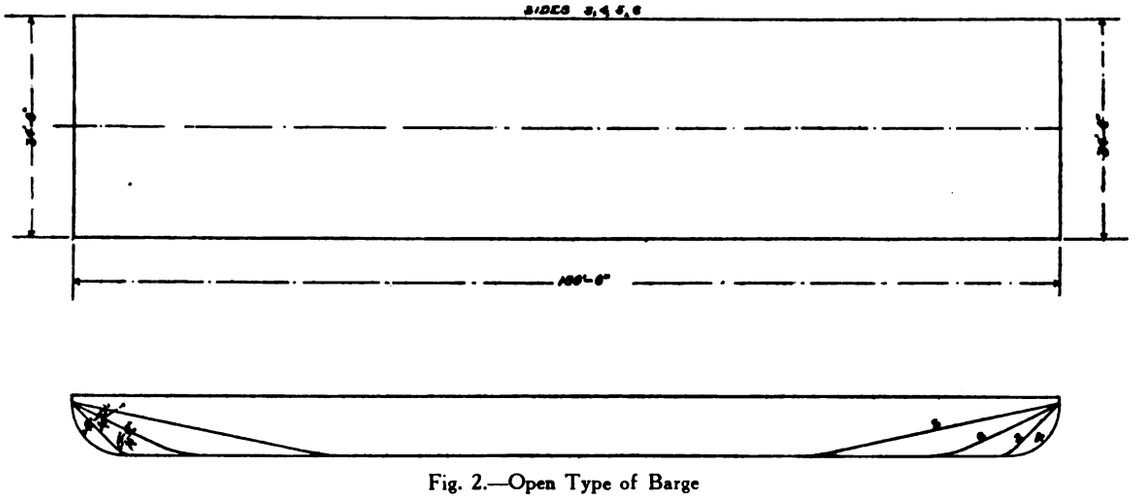

Fig. 2.—Open Type of Barge

* Consulting Engineer, Marine Terminals, New York.

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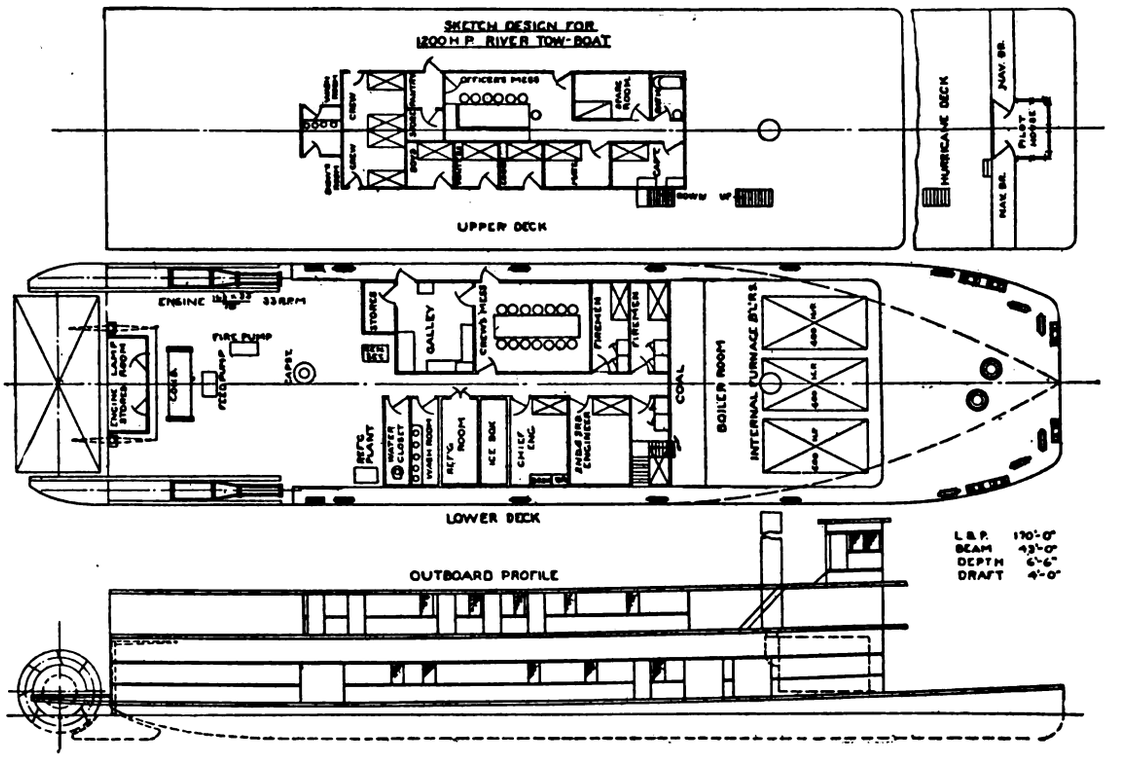

Fig. 3.—Stern-Wheel Towboat

2. How many barges should there be in a tow, and what should be the relative formation of the tow?

3. What should be the design of the towboat, its length, width and draft?

4. What are the most practical types of engines and boilers; what horsepower is required? Should the side-wheel, stern-wheel or tunnel-screw propeller be used? If stern-wheels are used, should they be of the feathering or radial type? What is the most efficient diameter for the wheel?

RECOMMENDATIONS

A summary of the board's recommendations follows:

1. The adoption of the types of barges shown in Figs. 1 and 2 and the construction of six of each of the barges. The decked barges, Fig. 1, are 150 feet long, 34 feet beam; the open barges, Fig. 2, are 150 feet long, 34 feet beam,

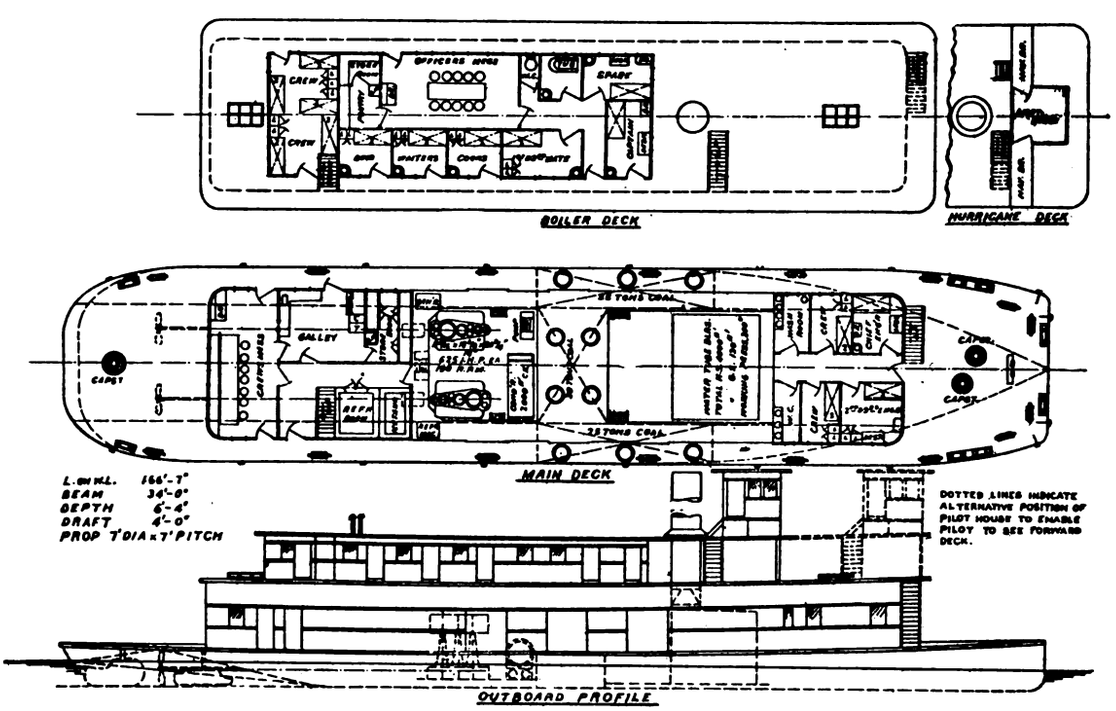

Fig. 4.—Twin-Screw Tunnel Towboat

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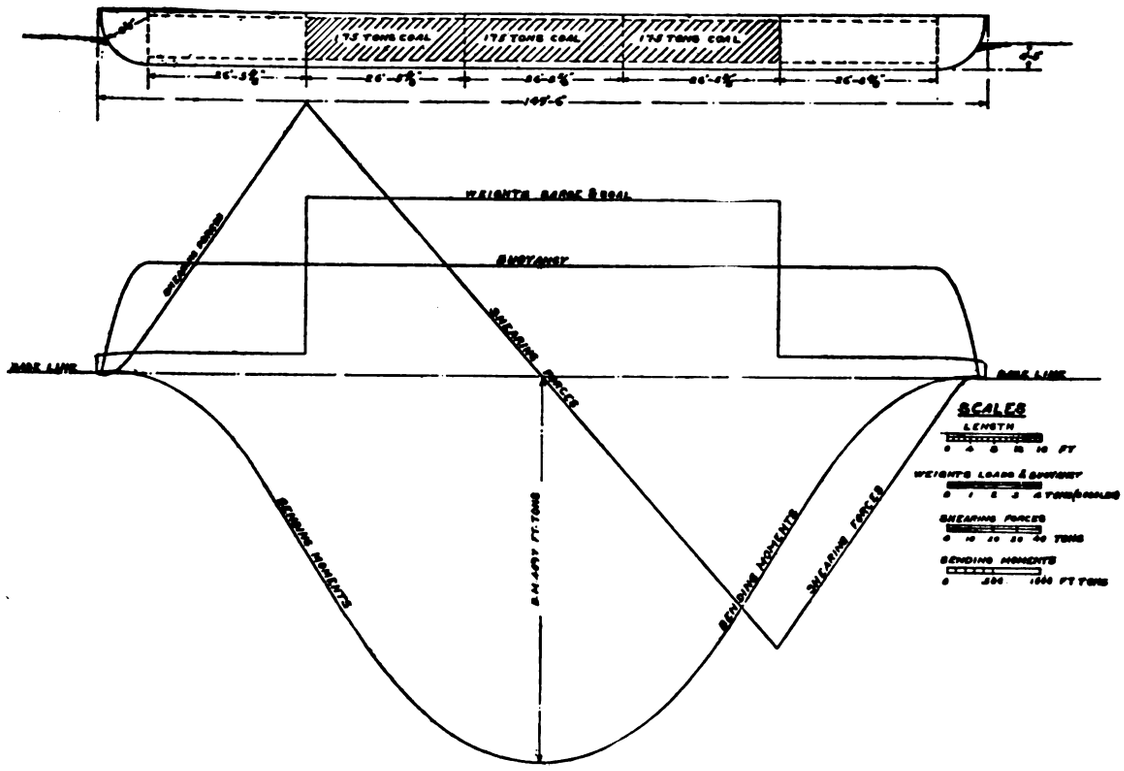

Fig. 5.—Shearing Forces and Bending Moments

weighing 45 short tons, with a carrying capacity of 880 short tons.

2. The construction of two towboats, one of the stern-wheel type with feathering wheel, Fig. 3, and one of the twin-screw tunnel type, Fig. 4. The stern-wheel towboat has a beam of 43 feet, a draft of 4 feet, and engines of 1,200 indicated horsepower. The twin-screw tunnel boat has a beam of 34 feet, a length between perpendiculars of 170 feet and a draft of 4 feet.

3. The boilers of the stern-wheel boats shall be of the

ESTIMATED WEIGHTS AND COSTS OF A 1000 I.H.P. RIVER TOWBOAT INSTALLATION (EXCL. ALL AUX. EXCEPT CONDENSING PLANT) WITH VARIOUS TYPES OF MACHINERY AT 180# BLR. PRESS.

	TYPE	ENGINES: PISTON SPEED F.P.M.	ENGINES: WEIGHT LBS.	ENGINES: COST $	ENGINES: STEAM PER H.P. HR LBS.	BOILERS: TYPE	BOILERS: TOTAL H.S. ft²	BOILERS: TOTAL G.S. ft²	BOILERS: WEIGHT EMPTY LBS.	BOILERS: WT. OF WATER LBS.	BOILERS: WT. BLR. & WTR LBS.	BOILERS: COST $	CONDENSER: WEIGHT LBS.	CONDENSER: COST $	ENTIRE PLANT: TOTAL WT (INC. WTR.) LBS.	ENTIRE PLANT: TOTAL COST $	ENTIRE PLANT: COAL PER H.P. HR. LBS.
LONG STROKE	SIMPLE, NON-CON.	200-225	72000	9000	33000	FLUE	4200	140	258,000	75000	310000	10290			382000	19290	3830
	COMP. COND'G	200-250	128000	12800	20000	"	2500	83	140000	46000	186000	6125	35000	3500	349000	22425	2820
	" "	" "	"	"	"	SCOTCH (WARD'S STR. T.)	3000	100	133500	66500	200000	13300	"	"	363000	29600	2250
	" "	" "	"	"	"	B&W	4500	104	80000	11250	91250	12350	"	"	254250	28650	"
	" "	" "	"	"	"	B&W	4500	112	131000	32000	163000	13600	"	"	326000	29900	"
	TRIPLE, COND'G	400	200000	20,000	16000	FLUE	2000	67	112000	37000	149000	4900	"	"	384000	28400	2100
	" "	"	"	"	"	SCOTCH (WARD'S STR. T.)	2400	80	106800	53400	160200	10660	"	"	395200	34160	1800
	" "	"	"	"	"	"	4000	91	70000	10000	80000	11000	"	"	315000	26500	"
	" "	"	"	"	"	B&W	3600	90	104000	25600	129600	10900	"	"	364600	34400	"
SHORT STROKE	WARD, ICR, T. EX.	600	28000	11000	"												
	" " "	"	30600	11000	"	WARD'S STR. T.	4000	91	70000	10000	80000	11000	"	"	145600	26500	"
	ORDINARY, VERTICAL TR. EXP.	"	150000	15000	"	WARD'S STR. T.	4000	91	"	"	"	"	"	"	265000	29500	"
	ORD. VERT. COMP.	"	100000	12500	20000	"	4500	104	80000	11250	91250	12350	"	"	296250	28850	2250
	DIESEL (OIL)		120000	81000											120000	81000	1500

COMPARATIVE YEARLY ECONOMIES OF THE ABOVE TYPES OF INSTALLATION.
FIXED CHARGES 18% ON INVESTMENT.
OPERATING TIME, 300 DAYS OF 12 HRS.
COST OF COAL, $3.00 PER SHORT TON.

	TYPE OF ENG.	TYPE OF BLR	FIXED CHARGES	COST OF FUEL	F.C. FUEL
LONG STROKE	SIMPLE, NC., 200 F	FLUE	$ 3472	$ 20700	$ 24172
	COMP. COND. 225 F	"	4036	12500	16536
	" " "	SCOTCH MARINE	5328	12150	17478
	" " "	WARD'S STR. T.	5157	12150	17307
	" " "	B&W, W.T.	5382	12150	17532
	TRIPLE, 400 F	FLUE	5112	11340	16452
	" " "	SCOTCH MARINE	6149	9720	15869
	" " "	WARD'S STR. T.	6210	9720	15930
	" " "	B&W, W.T.	6192	9720	15912
SHORT STROKE	WARD, ICR, T. EXP.	WARD'S STR. T.	9590	9720	19310
	ORD. VERT. T. EXP.	WARD'S STR. T.	5310	9720	15030
	ORD. VERT. COMP.	" " "	5103	12150	17253
	DIESEL (OIL)	(OIL @ $1.00 per BBL)	14580	5715	20295

NOTE:
IN THE CASE OF ITEMS # 1 & 2 (SIMPLE, NON-COND, AND COMP COND, LONG STROKE) THE EFFECT OF DOUBLING THE PISTON SPEED IS TO REDUCE THE WEIGHT AND COST OF ENGINE BY ABOUT 40%

THE AUTHORITIES FOR WEIGHTS & COST OF THE ABOVE LONG STROKE ENGINES ARE.
JAS. REES, SONS & CO.
PITTSBURGH
GILLETT, EATON & SQUIRES
LAKE CITY, MINN.

NOTE.
THE BONSON BOILER IS OF ABOUT THE SAME WEIGHT PER # OF H.S. AS THE BABCOCK & WILCOX SEMI-MARINE QUOTED ABOVE, AND ABOUT 15% CHEAPER ON THE SAME UNIT.
TWO "HEINE" SEMI-MARINE BOILERS WITH A TOTAL H.S. OF 4884 SQ. FT. WEIGH (WITH WATER) 222000 LBS. AND COST $9000.

Fig. 6.—Table of Estimated Weights and Costs of 1,000 Indicated Horsepower Towboat

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internally-fired retuhn-tube type or the combination fire and watertube type with straight tubes, the engine being of the tandem compound condensing or similar type.

4. The tunnel design boat shall be provided with sectional propellers made of cast steel. In the case of steam propulsion the boiler shall be of the combination type, or watertube type, with straight tubes, and the engines of the

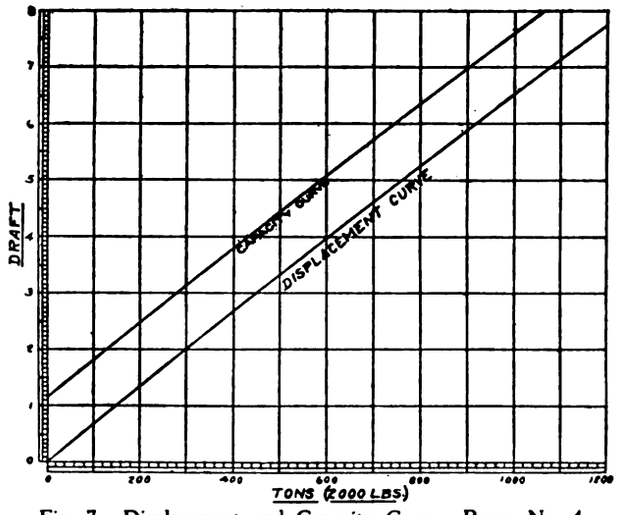


Fig. 7.—Displacement and Capacity Curves, Barge No. 4 (See Fig. 9)

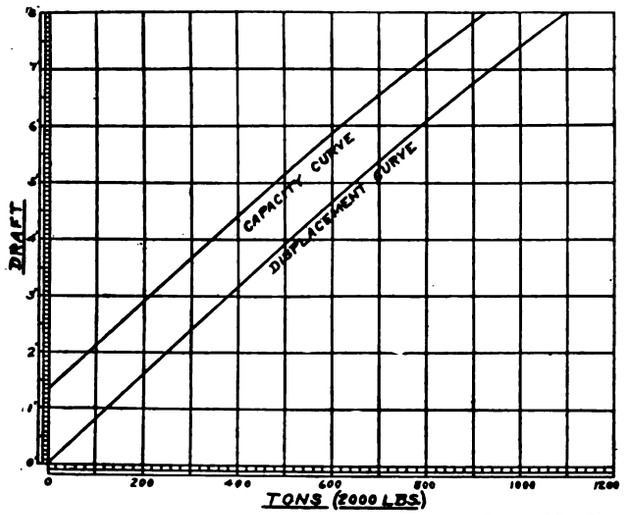


Fig. 8.—Displacement and Capacity Curves, Barge No. 2 (See Fig. 9)

triple-expansion type, or in place of steam power internal combustion engines may be used with gas producers.

Among the many valuable deductions given in the report resulting from the studies and investigations made the following are noteworthy:

ECONOMICAL SPEED FOR UPSTREAM TOWING

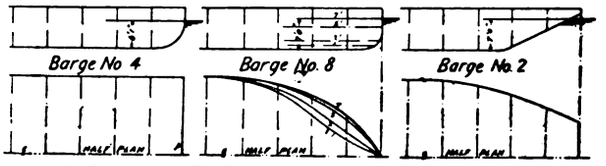
The economical speed for upstream towing is 50 percent greater than the velocity of the stream. If the speed of the current at low water is found to be 3.5 miles per hour on the lower Mississippi, the most economical still-water speed from the point of view of power required is 5.25 miles per hour.

To compare the power required to tow a fleet of six barges with that required for a single barge of the design recommended at the speed of 5.25 miles per hour, it was found that at full-load displacement in 9 feet of water the fleet of six barges developed only 3.5 pounds resistance per short ton of displacement, as against 4.75 pounds for the single barge, making a saving of about 25 percent for the fleet formation. This may be accounted for to some extent by the fact that the fleet, when lashed rigidly together, is practically a large barge. At the same displacement and in the same depth of water, the resistances per ton of displacement for the same barge, when towed in groups of 2, 3, 4 and 5, at 5.25 miles per hour, are

Cost of Freight Transportation in various forms of Barges and at various speeds and depths

Per cent of total investment for fixed charges - 18%
Investment per ton of capacity Barges - $ 15 00
Investment per I H P in Towboat - $ 100 00
Cost of Coal per ton (2000 lbs) - $ 3 00 Towing hrs. Yr (300 × 12) = 3600
Coal consumption per I H P - .274 lbs Wages & subsistence. Yr - $ 20000
T-A H P derived from model basin experiments on fleets of five & six barges lashed together, 3 long & 2 wide Fuel cost per C. = 30%

No. of Barges	Total displ.	Total capy	Barge No	Miles per Hr	Towrope H P	I H P	Per ton mile: lbs of Coal	Cost of Coal $	Wages & Subsistence $	Fixed Charges $	Total cost of Transportn. $
							in 9 ft of water				
Six	5600 Short Tons	4500 Short Tons	2	7	695	2317	166	.000249	.000177	.000472	.000898
				6	416	1386	115	.000172	.000206	.000382	.000760
				5	240	800	080	.000120	.000247	.000328	.000695
			4	7	645	2817	201	.000302	.000177	.000554	.001033
				6	475	1583	132	.000201	.000206	.000417	.000824
				5	246	820	082	.000123	.000247	.000332	.000702
			8	7	860	2867	205	.000307	.000177	.000562	.001046
				6	480	1600	133	.000200	.000206	.000421	.000827
				5	258	860	086	.000129	.000247	.000341	.000717
							in 12 ft of water				
			2	7	673	2243	160	.000240	.000177	.000463	.000880
				6	400	1333	111	.000167	.000206	.000372	.000745
				5	227	757	076	.000114	.000247	.000326	.000685
			4	7	684	2280	163	.000245	.000177	.000410	.000892
				6	416	1387	115	.000172	.000206	.000382	.000760
				5	228	760	076	.000114	.000247	.000319	.000680
			8	7	579	1930	138	.000207	.000177	.000413	.000797
				6	320	1067	.089	.000134	.000206	.000322	.000662
				5	173	573	057	.000085	.000247	.000282	.000614
							in 9 ft of water				
Five	4660 s. Tons	3750 s Tons	2	6	299	997	099	.000149	.000247	.000346	.000742
				5	205	683	082	.000123	.000296	.000332	.000751
			4	6	280	933	093	.000140	.000247	.000332	.000719
				5	205	683	.082	.000123	.000296	.000332	.000751
			8	6	270	900	090	.000135	.000247	.000325	.000707
				5	180	600	072	.000108	.000296	.000310	.000714



All Barges are 150'0" × 34'0". 932 short tons displacement. Bow & Stern identical.

Fig. 9.—Table of Transportation Costs

respectively 12.5 pounds, 5.85 pounds, 5.4 pounds and 3.65 pounds. With more than one barge the obvious advisability of increasing the number of barges in a tow to the greatest permissible limit is confirmed by the above figures.

MATERIAL FOR BARGES

Taking into consideration the first cost, repairs, length of life and frictional resistance, the steel barge, though costing more than twice as much as a wooden barge ($6,000 for wood and $13,000 for steel), is the more economical in the end.

A committee of the engineers traversed portions of the principal rivers of Germany, Belgium, Holland, Austria and France, and first investigated and considered types of boats in use for similar river purposes; then visited the principal boat and engine-building plants of these countries and Great Britain, and also inspected the loading and unloading appliances in the principal harbors of these countries. The report justifies the conclusion—

1. That towing by European methods is not suitable on the Mississippi River and its tributaries.

2. That, while several features of the towboats on the

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European rivers are worthy of consideration, towing by towline is not considered practical upon our Western rivers on account of the physical conditions and the necessity of having a crew on each barge.

3. Most compound or triple-expansion engines, with superheated steam and feathering wheels and possibly Diesel engines, give good results.

4. That the choice of towboats is limited to three types —the side-wheel, stern-wheel and tunnel propeller.

The side-wheel boat is the predominant type on European rivers. This is doubtless due to the method generally adopted there of towing the fleet astern of the towboat, which, as stated above, is not applicable to our Western rivers.

In American practice on shallow rivers the principal function of the towboat in downstream traffic is to control the movement of the tow in passing bends by flanking. By reason of the large balanced rudders used on the

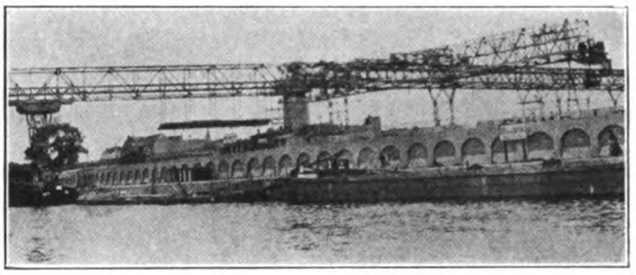

Fig. 10.—Unloading Plant at Storage Yard, Berlin, Germany

stern-wheel boats, these can develop much more flanking power when backing than it is possible to obtain with the side-wheel boat. This consideration was believed by the engineers to be of sufficient importance to eliminate the side-wheel boat for towing purposes upon our Western rivers. It is stated in the report that the tunnel propeller boat has been successfully used when towing astern the same as the stern-wheel type.

After many experiments to determine the best type of towboat, it was found that a boat 43 feet wide and 4 feet draft, fitted with a stern wheel 14.6 feet in diameter, having 10 blades, the depth of immersion being 3 feet 6 inches, gave the best results. Many tables are given as to thrust, immersion, diameter of wheel, dimension formulæ, slip, efficiency for different-sized wheels of both the radial and feathering types, with many comparisons. The tables of the results of boiler tests being made by the Mississippi River Commission from boats in operation are of special value.

The designs of the barges adopted are shown in Figs. 1 and 2, Fig. 1 being for the decked and Fig. 2 for the open barge. Fig. 3 shows the stern-wheel towboat design and Fig. 4 the tunnel-propeller towboat design.

The tables of curves of displacement, of which there are some forty-eight in the report, will well repay careful study, as well as the many other plotted curves, showing at different depths of water the effects of different numbers of barges in total resistance both with the barges empty and partially or wholly loaded, and also in different arrangements of formation; also the curves of steering experiments and of thrust, torque and efficiency, immersion and rudder moments. The curves of maximum transverse and longitudinal bending moments for the types of barges selected are of great interest. There is a table of the estimated weights and costs of a 1,000-horsepower river installation of various types of machinery, with fixed charges of operation and the cost of fuel.

Within the past few years since it has become evident that the disinterested efforts of such men as Hon. Thomas Wilkinson of Burlington, Iowa, president of the Upper Mississippi Improvement Association, have borne fruit, and that profitable Mississippi river transportation is becoming an accepted fact, many different types of barges have been tried out on the river, but much of the difficulty in selecting the proper equipment for such work will be overcome by a careful study of a part of the Government engineers' report, which has been prepared by Professor Herbert C. Sadler, professor of naval architecture

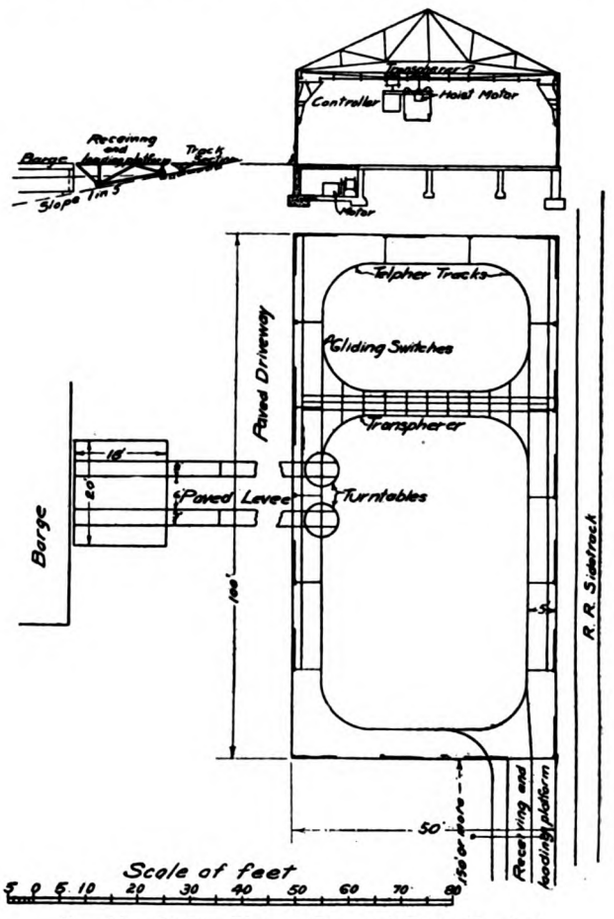

Fig. 11.—Outline Plan of Proposed River Terminal

and marine engineering, at the University of Michigan, dealing with barge and towboat forms and tests. There is no doubt but that Professor Sadler's advice as to the types of power boats, or barges, for any particular kind of freight service on either shallow or deep rivers will be of great value and assistance.

At the end of the complete report there is a description of an excellent type of river boat now operating on the Black Warrior River, designed by John H. Bernhard of New Orleans, and which will probably be used extensively on all of the Western rivers and Eastern canals.

Another portion of the report which is of interest discusses the handling of freight. Based on experience abroad, it is evident that in loading and unloading barges there should be vertical movements coupled with the use of the horizontal overhead conveyors.

M. E. B. A. No. 33 ANNUAL ENTERTAINMENT.—The annual entertainment and ball of the M. E. B. A. No. 33 will be held on Wednesday evening, December 2, at the Lexington Avenue Opera House, Fifty-eighth street near Third avenue, New York City.

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The Towboat Industry on Western Rivers

Government Projects for River Improvement—Cost of Towing on Long and Short Hauls—Growth of the Towing Industry

BY M. VON PAGENHARDT *

During the last decade, navigation on the western rivers of the United States has undergone a complete change. The once predominant packet boat transporting passengers and miscellaneous freight at comparatively high rates has practically disappeared in the face of railroad competition. On the other hand, the towing business has developed from common rafting to a most substantial and important industry.

River Commerce 1912-1913

During the calendar year July, 1912, to June, 1913, commerce on the Ohio and Mississippi rivers amounted to 10,714,383 tons, with a valuation of $111,562,879 (£22,850,000). Seventy percent of this consisted of towing business, while, in addition, on the Ohio River 3,832,289 passengers were carried, although a very large percentage of this business was due to local excursion trade.

If to the above are added the extensive Monongahela River coal trade, amounting to several million tons a year, the Missouri River trade with its growing merchandise movement, and the rapidly increasing coal trade on the Alabama rivers, it is not astonishing to see the generous appropriations of the Federal Government expended for the benefit of navigation on the western rivers.

Government Projects

The year 1910 marks the turning point in the systematic development of the western rivers. By act of Congress the following projects were adopted:

A 9-foot channel in the Ohio, to be completed in twelve years. An 8-foot channel in the Mississippi from Cairo to the mouth of the Missouri River, to be completed in twelve years. A 6-foot channel in the Mississippi from St. Louis to Minneapolis, to be completed in twelve years. A 6-foot channel from Kansas City to the mouth of the Missouri River, to be completed in ten years. A 9-foot channel from Cairo to New Orleans, the time of completion indefinite.

At the present time, in the Mississippi River between St. Louis and New Orleans, there is an 8-foot channel at the lowest stage of water. On the Ohio project, which comprises fifty-four locks and dams, twelve are now finished and under operation. One dam, No. 26, was completed but was carried away by high water in 1912, and will be repaired this year. Nine others are nearing completion, while the contracts have been let for seven more, leaving twenty-five others still to be undertaken. Even now, however, a channel depth of 4 feet is available at the lowest stage of water. On the Mississippi River the work between Cairo and St. Louis is 30 percent completed; the work on the upper river, 40 percent complete; the work on the Missouri River, 15 percent complete; the work on the Tombigbee and Warrior rivers in Alabama, 87 percent complete, while the work on the lower Monongahela River has been finished.

Results of River Improvement

The extent to which such improvements aid the navigation interests is shown by the following figures which a prominent coal firm operating on the improved Monongahela River courteously gave to the writer. This company, with a fleet of five 500-horsepower towboats and 100 barges, transports coal from a point 65 miles above Pittsburg down the Monongahela River to Pittsburg. The actual cost of transportation per ton varies between 4 and 5 cents (2 to 2½d.), as is shown in the following figures:

Yearly Expenses of a 500-Horsepower Towboat

Wages	$11,000 (£2,260)
Repairs	1,500 (308)
Fuel	6,000 (1,230)
Lubrication	1,500 (308)
Commissary	3,500 (718)
Insurance	540 (111)
Tonnage	600,000
Cost per ton	4 cents (2d.)

To this might be added the cost of loading and unloading the barges. The loading, however, is done very cheaply, as the coal mines are situated close to the river and the mining cars coming from the mines run out over the barges, where they are automatically unloaded. The cost of loading is, therefore reduced to less than ½ cent (¼d.) per ton.

The cost of unloading the barges is given as 3 cents (1½d.) per ton, which is a remarkably low figure. The unloading is done by means of a continuous chain elevator with a capacity of 5 cubic yards per bucket and an unloading capacity of 500 tons per hour. The coal is delivered on to a belt conveyor having a running speed of 20 feet per second, conveying the coal to hoppers above the coke ovens.

To the above costs there must be added the depreciation and interest on the total investment, which is estimated at $1,500,000 (£308,000) for a yearly capacity of 3,000,000 tons. Allowing 10 percent for depreciation and 5 percent for interest, the sum of $225,000 (£46,200), or 7.4 cents (3.7d.) per ton (which is double the cost of transporting or conveying the coal) must be added, bringing the total cost per ton, including overhead expense, to about 15 cents (7½d.) per ton, or 2.3 mills per ton mile. The railroad rate between the same points is 45 cents (1 10½) per ton, or three times the amount by water, and it might be added that the railroad could not handle the same daily tonnage as is handled on the water.

Cost of Operation

Investigation of the operating details of such towboats and barges shows that the crew of each towboat consists of fourteen men; that is, one master, one pilot, one engineer, one assistant engineer, two firemen, a cook and helper, and six deckhands.

The repair bill of $1,500 (£308) per year, given in the table above, is due chiefly to boiler trouble. From 60 to 75 percent of the repair bill is accounted for by repairs to boilers, while the remainder is accounted for by repairs to the wheels made necessary by the heavy pounding of the wheels through ice in winter time. The boiler repairs consist principally of replacing burned sheets. The type of boiler used is the externally-fired, return flue boiler with flues of large diameter in a shell of about 42 inches diameter and 28 feet length. Ordinarily three of these boilers

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are mounted over a common furnace, and, although they are reliable steamers, allowing a high rate of forcing, they are, nevertheless, subject to breakdowns due to burned sheets.

The lubrication bill, given above, seems unnecessarily high, while the fuel bill of $6,000 (£1,230) per year figured on a consumption of 6,000 tons of coal per year at $1 (4/2) per ton, is remarkably low. The cheapness of the coal is, of course, due to the nearness of the coal fields and to the fact that the mines are owned by the company. But even considering this relationship of the common ownership of the boats and the coal fields, the coal consumption of 6,000 tons per year is remarkably low for western river conditions, and can be explained only by the down-stream movement of this coal. Each towboat has to make in the neighborhood of 240 round trips per year, each trip averaging thirty-six hours, to move 600,000 tons of coal per year. Each towboat, however, cannot consume more than 25 tons in thirty-six hours, or 3 pounds per horsepower hour, which is a rarely attained fuel economy on western rivers. This means that 2,500 tons of coal or freight are moved on the river with a fuel consumption of ¾ ton per hour, while on the Great Lakes 2,500 tons of freight are moved with a fuel consumption of ½ ton per hour. Additional data regarding fuel consumption on the western river towboats are desirable.

The handling of these stern-wheel boats for down-stream towing is remarkable. They are 158 feet to 160 feet long overall, 24 feet to 26 feet wide and 5½ feet deep, drawing 5 feet of water at the head when coaled with 40 tons and not quite 4 feet at the stern. The length between stem and transom is 135 feet, the diameter of wheel, 20 feet, the width of bucket 30 inches, and length of bucket 16 feet to 18 feet.

Barges

The barges originally used were 100 feet long, 24 feet wide and 8½ feet deep. Five of these barges, with a towboat, make up a towing unit. Since the widening of the locks, the barges and boats have been made 26 feet wide, while in recent years steel barges, 200 feet long, are being built, thus replacing two of the wooden barges. The advantages of the longer steel barge over the two smaller wooden barges are smaller first investment per ton of carrying capacity, quicker loading and discharging of the cargo, less resistance per ton through the water, greater carrying capacity for the same dimensions of towboat unit, lighter draft when empty, and greater capacity on the same draft.

These steel barges are all of the same pattern, the hull being of quarter-inch open-hearth steel, built with a semi-circular bow and stern of 10-foot radius with square sides 8 feet 7 inches depth, with a 16-inch sheer on either end, drawing 12 inches of water when light. They are almost all a full box shape, with an 8-inch round knuckle plate of ⅜-inch steel, with bow and stern rake plates of 5/16-inch steel.

The coal is carried in steel hoppers sheathed with wood, the carrying capacity of each barge on a 7½-foot draft being 1,100 tons. The wooden barges, while drawing only 12 inches when new, gradually become waterlogged and draw as much as 18 inches light after they are about four years old. The life of the steel barge is about four times that of a wooden barge. Two of these steel barges ahead of the towboat, and one wooden barge of 500 tons capacity alongside the towboat, make up a tow of 360 feet by 52 feet overall dimensions with a combined carrying capacity of from 2,500 to 2,700 tons of coal. An average speed of 6 to 7 miles per hour can be maintained either up or down stream, as the coal movement is a down-stream movement, while the up-stream movement consists only of towing empty barges. The round trip is completed in twenty-four hours.

Handling of the Stern-Wheel Towboats

The reliable handling of these stern-wheel towboats in the down-stream movement is due to the position of large rudders forward of the stern wheel. This feature, which is otherwise a handicap, proves of advantage in quick flanking and maneuvering of the heavy tow. The action of the water from the wheel on the rudders when stopping or flanking is immediate, and anyone who has watched these towboats deliver their barges at landings and take out empty or loaded barges, is tempted to believe the pilot's boast that he can thread a needle with his boat. The heavy weight of the boat, otherwise a disadvantage, proves a great aid in this particular down-stream movement, and for handling work. The large paddle wheel is in any case an efficient propeller, and its high efficiency is maintained even at low speed, while the small screw propeller of restricted diameter, such as is necessary in shallow draft boats working in a tunnel under the stern, loses its efficiency rapidly with the falling off from the normal speed of the propeller.

On the other hand, the serious handicap of the stern-wheel boat is the unfavorable distribution of weights; the bad steering qualities when going ahead and the laboring in shallow water due to the squatting of the boat at the stern and the consequent deeper immersion of the wheel. According to curves published by Professor Herbert C. Sadler, of the University of Michigan, showing the relation between squatting and increasing load, squatting and speed, squatting and channel depth, it is shown that up to a speed of 8 or 9 miles through the water in boats of 150 feet length and over the squatting is serious only if 6 feet of water and less are under the bottom of the boat. There are stern-wheel boats that are known as squatters and others as shallow water runners, for which 8 feet of water is sufficient to run in with a fair speed. This is due to the design of the stern, the position of the wheel relative to the hull and the trim of the boat. A towboat has in addition to that the advantage that her nose is hooked solid into the barges which she tows, keeping her from squatting.

The heavy stern-wheel boat engines, even of the more modern compound type, seldom require repairs. Some of them have run for twelve years in day and night service every day in the year with only a few dollars' worth of repairs. These engines are of 500 horsepower of the tandem compound type, with 12-inch high-pressure and 24-inch low-pressure cylinders and a stroke of 72 inches, turning at from 16 to 18 revolutions per minute, supplied with steam at 200 pounds pressure with cut-off at ⅝ of the stroke. As these boats are operated day and night through locks, leaving loaded barges at one place and taking up other barges at various landings twice in twenty-four hours with only one engineer on watch in the engine room, it is evident that the engines have come up fully to requirements of endurance and reliability. The general construction of the engines is simple; all parts are of ample dimensions, and all movements are extremely slow, thus the parts are subjected to very little wear. If it were not for the fact that these engines are entirely too heavy, too clumsy in their design and too wasteful of steam in their operation, they could be called an unqualified success.

Long Distance Towing

The comparison between the cost of transportation by

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water and by railway, as shown in the above case, is typical for the new towing industry on western rivers. It shows what has been done on an improved river and indicates what can be done elsewhere. It is true that there are not many of these enterprising organized towing companies on the western rivers, but there is room for an unlimited number of such concerns. Navigation on the Monongahela River is by no means a slack water navigation, in spite of the great number of locks, and cannot be compared with the Warrior and Tombigbee system in the Alabama coal districts, which is a typical slack water navigation for barges drawing 6 feet.

Furthermore, this Monongahela towing industry, being short distance navigation, is not typical of the towing industry on the Ohio and Mississippi rivers. It is slightly in advance of the widely known towing movements of the large coal fleets on the Ohio and Mississippi rivers, which is distinctly a long distance navigation. The ton-mile cost diminishes in direct proportion to the increase in tonnage and distance, and it will be found that in the large coal fleets on the Ohio and Mississippi the cost of transportation is reduced to a quarter of a mill per ton-mile, even with an unnecessary high daily towboat expense, while the Monongahela coal is moved at a cost of .6 mill per ton-mile. The large coal fleets, however, move in units of 40 barges of 1,000 tons each, or in units of 40,000 tons from Louisville, Ky., to New Orleans, La., the empty barges returning in forty days. The daily towboat expense is $300 (£62), or the coal is transported a distance of 1,500 miles for $12,000 (£2,480) at a rate of .2 mill per ton-mile. To this figure, however, must be added the heavy depreciation of the cheaply-built wooden barges and the great losses through storm and navigation hazards, which bring the total cost to an unproportionately higher figure.

The cost of loading is almost negligible, as the loading of this coal is accomplished by gravity. The unloading is done at the expense of the buyer. If he has to do it by hand labor, it will cost an average of 25 cents (1/0½) per ton, or as much as the total cost of transportation. It is customary, however, in western river towboat practice, to buy a whole barge load of coal and take the barge as a fuel flat alongside the boat and unload the coal during the voyage as needed. Thus the unloading is done by deckhands which have to be carried on the voyage, anyway. Of course this argument is in many cases misleading, as the deckhands refuse to do the coal passing and a great number of special coal passers have to be carried on the boat for the simple purpose of unloading this coal. Thus the unloading expense appears in the end as a heavy part of the running expense of the towboat. As a matter of fact, it is seldom realized what enormous quantities of coal are consumed daily on these large towboats. A thousand horsepower towboat with special high-pressure engines consumes 7 tons of coal per day, or as much as a 4,000 horsepower ocean or lake vessel would consume. Furthermore, twelve coal passers have to be carried to handle the coal. The introduction of compound condensing machinery reduced this consumption by about 40 percent, but obviously there is still room for improvement.

MOVEMENT OF MERCHANDISE

The movement of merchandise is necessarily a great deal more expensive than the movement of bulk freight, as a smaller quantity is moved at a time and an additional item has to be charged against the cost of transporting each ton of freight, namely: the soliciting of the freight and the heavier overhead expense. Also the handling of the freight is more expensive, although it is of interest to note that the handling expense, while higher per ton, is a much smaller fraction of the total expense than in the movement of bulk freight. The St. Louis Navigation Company, which was operating some barges and a towboat from St. Louis to New Orleans in 1911, showed the following division of expenses:

1. Actual cost of transportation per ton, $2.75 (11/5½); actual cost of transportation per ton-mile, 2.2 mills.

2. Loading and unloading per ton, 95 cents (3/11½); loading and unloading per ton-mile, .75 mill.

3. Overhead expense, soliciting per ton, $1.25 (5/2½); overhead expense per ton-mile, 1 mill.

Total expense per ton, $4.95 (1/07/½); total expense per ton-mile, 3.95 mills.

The average railroad rate for the commodities carried was 25 percent higher than the water rate, but the actual cost of water transportation, almost 4 mills per ton-mile, was too high to be on a strong competitive basis with the railroad. The first item could be reduced by carrying a greater tonnage and by reducing the towboat expense. With lower daily operating expenses, some towing companies move such freight as lumber, coal and stone in 2,000 and 2,500-ton units up-stream in the existing 8-foot channels in the Mississippi for a cost of 1 mill per ton-mile, and in stretches allowing a 6-foot draft for 1¾ to 2 mills per ton-mile. So there seems to be no reason why the cost of transportation of merchandise with the same towboat system cannot be reduced to the same proportional figure.

The second item, the terminal expense, can be reduced by building or improving river terminals, although this item cannot be reduced to the same extent as the cost of transportation. It must be borne in mind that the river terminal is more important as a feature of soliciting freight and distributing the freight than of the mechanical conveying and loading of the freight. In fact, the handling of this merchandise freight is merely a mechanical detail of more or less local character, while the efficient connection of the river terminal with the stores, railroads and transfer service is of an importance that cannot be overestimated.

The third item, the overhead expense per ton and ton-mile, will reduce itself automatically with the expansion of the merchandise movement.

CONCLUSION

It can be seen from the foregoing that the towing industry on the western rivers can be carried on with marked success wherever sufficient capital is invested and the modern means of management are adopted that are prevalent in other branches of freight transportation. The few remaining navigation companies on the western rivers, that still adhere to the independent packet boat service without railroad connections, lose in importance and prestige year after year, and will have to restrict their activities more and more to the local excursion trade, while the towing industry will gradually become an important feature in the problem of freight transportation.

NOTICE TO MARINERS.—A plant of the Merritt & Chapman Derrick & Wrecking Company is now engaged in laying a 36-inch submarine pipe line known as the Narrows Siphon across New York Bay from the foot of Seventy-ninth street, Brooklyn, N. Y., to Tompkinsville, Staten Island, N. Y. Passing vessels are requested to slow down and to give this plant as wide a berth as possible.

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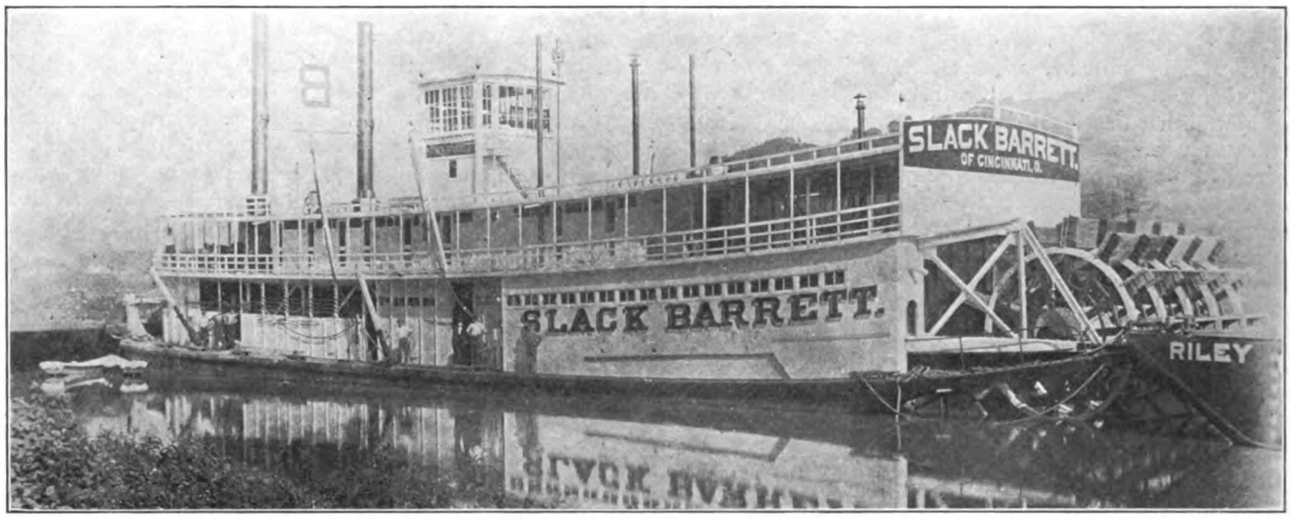

Fig. 1.—View of the *Slack Barrett* Ready for Service

Steel Stern-Wheel Towboat Slack Barrett

Light Draft Towboat for Use on the Ohio and Mississippi Rivers —Hog-Chain and Wheel-Chain Braces Replaced by Deep Trusses

The launching of the steamer *Slack Barrett* at the shipyard of the American Bridge Company, Ambridge, Pa., on March 31 of this year, marked a step in advance in construction of boats of this type, as the *Slack Barrett* was the first stern-wheel towboat of the Western River type to be built without hog-chain and wheel-chain braces. The hull and upper works, up to and including the boiler deck, were built entirely of steel, the only wood used in the entire construction being the cabin and pilot house above the boiler deck, and even here the paneling in the kitchen and laundry was of steel plating on a wooden frame.

The hull is 140 feet long, 32 feet wide on deck, and has a molded depth of 5 feet 3 inches at a point about 10 feet forward of the forward end of the cylinder timber. The sheer forward is 27 inches and aft 12 inches. The crown of the deck is 4 inches, the sides having a flare of 12 inches, turning into the flat bottom on a 12-inch radius. The bow of the boat is of the scow type, the deck line being brought in slightly, beginning at a distance of 8 feet from the end. The stern is also scow-shaped, the deck lines running parallel clear to the stern transom. Three "bustles" are built in the stern rake, thus keeping a constant clearance for the three counterbalanced rudders throughout their entire swing. The forward marginal lines of the "bustles" are bounded by a 1½-inch, half round, to prevent driftwood fouling the rudders. The length of both bow and stern rake is 20 feet.

Six transverse watertight bulkheads divide the hull into seven watertight compartments. Four longitudinal trusses are worked intercostally between the transverse bulkheads, being connected to the bottom and deck plating at

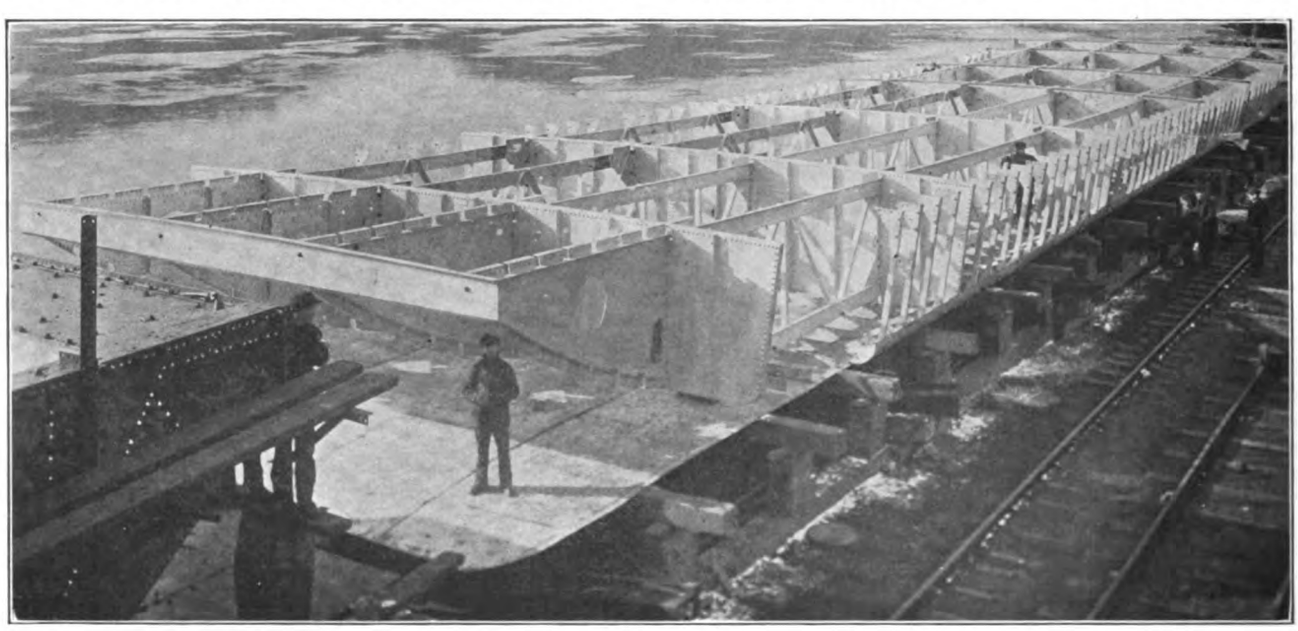

Fig. 2.—The Hull Under Construction, Showing Framing, Transverse Bulkheads and Longitudinal Trusses

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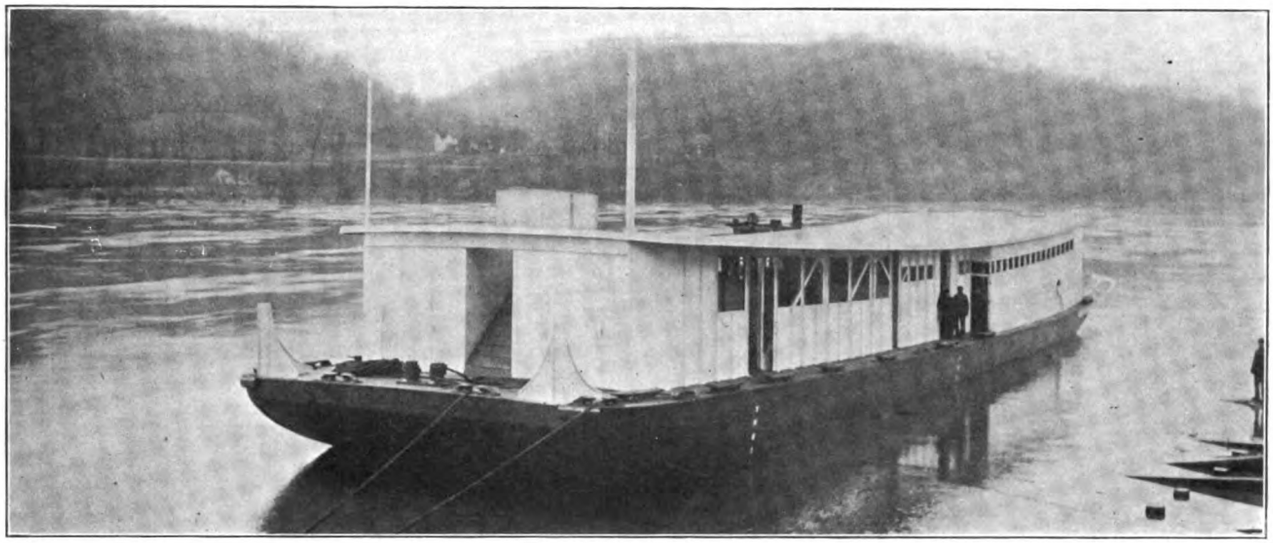

Fig. 3.—Hull of the *Slack Barrett* Just After Launching at the Ambridge Yards

their intersection, as shown in Fig. 2. The two inboard trusses are of the lattice type between bulkheads Nos. 1 to 6, while the two outboard trusses are of the lattice type between bulkheads Nos. 1 to 4, the remaining portions of all four trusses being non-watertight plate bulkheads, notched for the passage of deck beams and floors, which are continuous from side to side of the boat. The deep trusses which replace the hog-chains and wheel-chain braces are placed in the same vertical plane with the outboard trusses in the hull and with the wheel beam. Diagonal and vertical members of the deep trusses over the wheel beam are so located as not to interfere with the installation or operation of the engines.

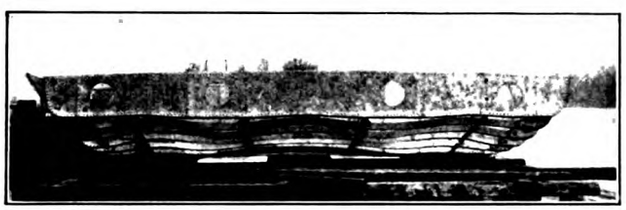

Fig. 4.—Stern Framing

The side walls, interior partitions and splash bulkheads between the main and boiler decks are all of 5-pound plating, suitably stiffened with angles.

The boat has two horizontal 40-inch boilers 28 feet long, with two 14-inch flues each. There is also an upright auxiliary boiler 44 inches in diameter and 8 feet long. The main boilers are allowed a working pressure of 224 pounds per square inch and make steam easily for the two tandem compound non-condensing engines. All of the live and exhaust steam pipes on the boat were furnished by the Charles Barnes Company, Cincinnati, Ohio.

The engines are 12 inches by 21 inches by 7 feet stroke and are equal to a simple engine 17 inches by 7 feet, or about 375 horsepower each. The engines drive a wheel 19 feet diameter and 22 feet long with fourteen 32-inch buckets at a speed of 23 revolutions per minute. With coal on board the boat draws 3½ feet of water.

The auxiliaries include a 10 kilowatt electric generator and a small turbine plant. A one-ton refrigerating plant cools a box 6 feet by 7 feet by 9 feet, inside measurement,

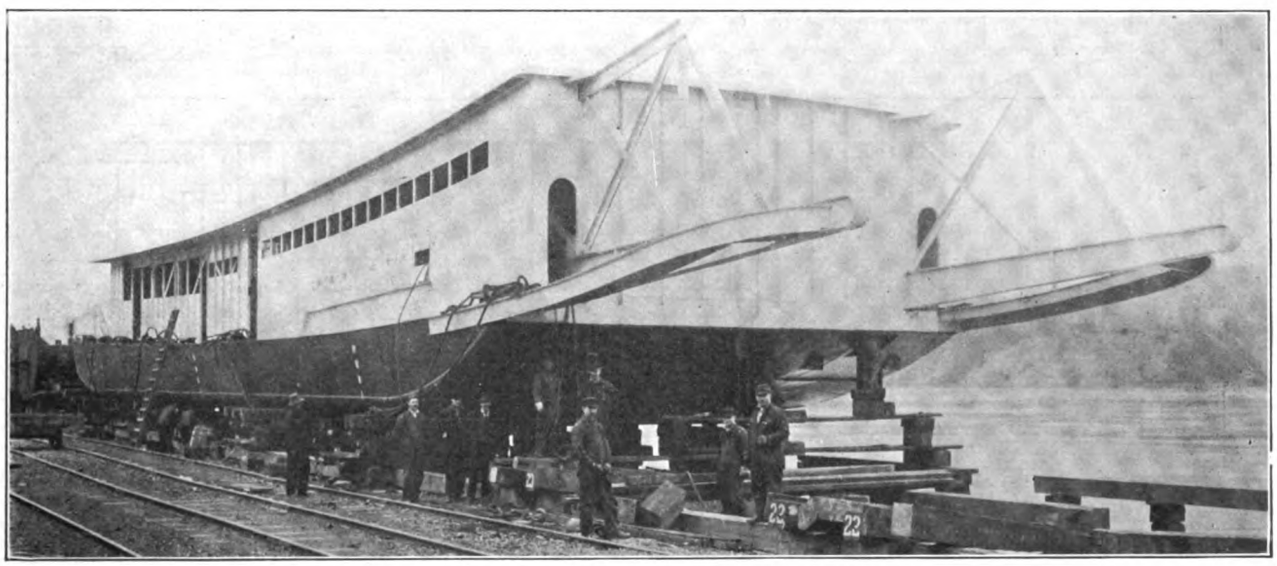

Fig. 5.—Stern of the *Slack Barrett*, Showing Deep Wheel Trusses

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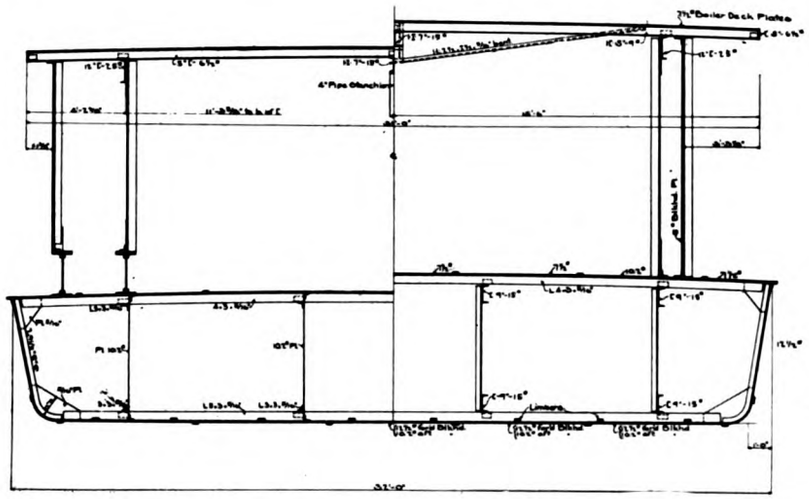

Fig. 6.—Midship Section

for 24 hours on 10 hours' running, besides making a small quantity of ice. By an arrangement of running coils through the brine tanks ice water is piped to sanitary drinking fountains throughout the boat.

Ten staterooms provide ample accommodations for officers and crew and two large and elaborately fitted staterooms are provided for the accommodation of guests.

The three large balanced rudders are operated by an improved steam steering gear supplied by the Charles Barnes Company, Cincinnati, Ohio. The steering device consists of a steam cylinder placed immediately over the rudders in close proximity to the stern of the boat. The steam cylinder is 8 feet long and is provided with a connecting rod that takes hold of the tiller directly. In turn the cylinder is provided with a very sensitive supply and exhaust valve of the rotary pattern perfectly balanced, so that its movement under pressure requires slight resistance in handling from the pilot house. Two vertical shafts extend up through the deck of the pilot house, one on each side of the large pilot wheel. These shafts are in turn united

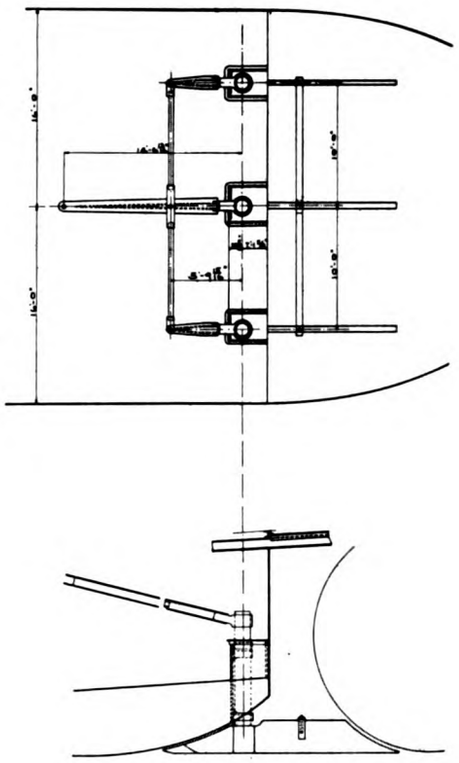

Fig. 8.—Arrangement of Rudders

by a sprocket chain under the deck of the pilot house. Both shafts move simultaneously, so that the pilot may handle the steering engine from either side of the pilot wheel. A third vertical shaft, connecting directly with a second sprocket chain, leads from the hurricane deck to the lower side of the boiler deck. The lower end of this shaft is provided with a double crank, which in turn is attached to fore and aft rods about 3/8-inch diameter leading back to the stern of the boat, where they connect to the steam valve. When the pilot desires to steer by hand

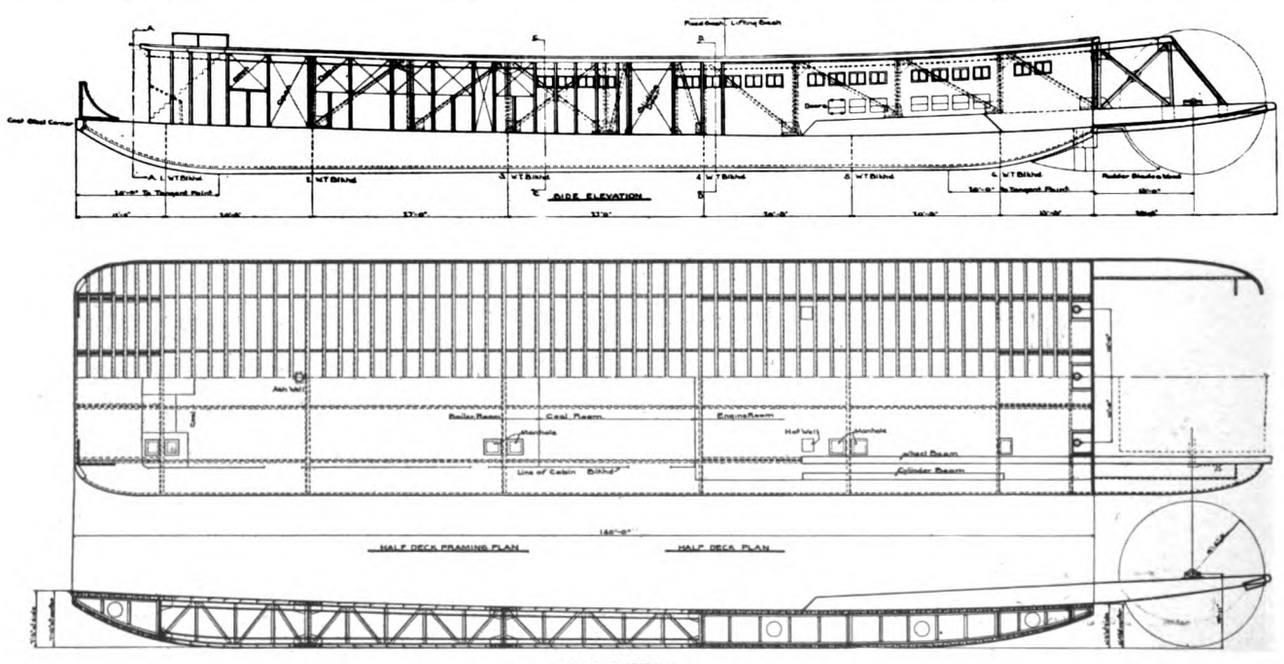

Fig. 7.—Construction Plans of Towboat Hull

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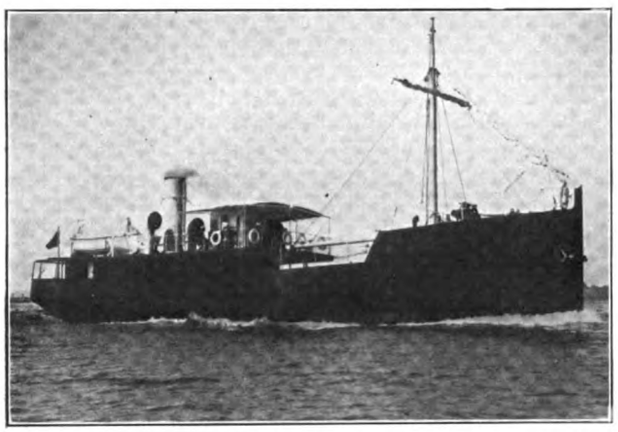
he simply moves the handle to a given point which is indicated by an index plate. An ingenious brake, operated either by steam or foot power, is attached to the steering device. If the pilot desires to cut off the steam he simply moves the handle to a given point, which is also indicated on the index plate. He then has perfect control of the brake by a treadle coming up through the pilot house floor and can use his brake by foot power without taking his hand from the pilot wheel.

Shallow Draft Steamers for Intercolonial Service

Three vessels, named the *Taff, Towy* and *Teign,* have recently been built by Messrs. Day, Summers & Company, Ltd., Southampton, for the Royal Mail Steam Packet Company's inter-colonial service, at the West Indies. The three vessels are each 110 feet long, 21 feet beam and 11 feet deep. They are fitted with single screw compound engines, having cylinders of 15 inches and 30 inches diameter and 24 inches stroke. A large hold forward is capable of carrying about 100 tons of cargo, giving the boat



Royal Mail Steamship *Taff*

a draft of 7 feet 6 inches. The boats are intended for day use and have only deck accommodations for passengers. A steam windlass, winch and steering gear are also fitted. It is claimed that a mean speed of 10 knots was obtained on the measured mile.

Crane Barge

A crane barge of novel design has been built and equipped by Messrs. Ritchie, Graham and Milne, engineers and shipbuilders, of Whiteinch, Glasgow, to the order of the Brazilian Government. The barge is 150 feet long, 50 feet wide and 8 feet deep, and is fitted with twin-screw engines, having cylinders 13 and 26 inches in diameter by 18 inches stroke. Steam is generated by two Babcock & Wilcox boilers. There is a complete salvage pumping plant, air compressor and diving apparatus, together with a steam windlass and steam winch. The 30-ton and 5-ton steam cranes installed were supplied by Sir William Arrol & Company, Ltd., Glasgow. The vessel has accommodations for officers and crew.

NEW YORK MOTOR BOAT SHOW.—The eleventh annual New York National Motor Boat Show will be held in Madison Square Garden, New York City, January 30 to February 6, 1915.

Single and Twin Screw Tugs for River Work

A type of single screw tug, suitable for both sea and river work, built by Edward Hayes, Watling Works, Stony Stratford, is illustrated in Fig. 1. The vessel is 51 feet long overall, 11 feet wide and 6 feet 2 inches deep at the side amidships, with a draft of 4 feet.

The engine is of a design specially suited to this type of boat and is a standard Hayes compound steam con-

Fig. 1.—Single-Screw Tug

densing set, with cylinders 8 inches and 16 inches in diameter by 10 inches stroke. Steam is supplied by a return tubular boiler, of the marine type, built under Lloyd's Survey to work at a steam pressure of 120 pounds. The engines drive a three-bladed propeller designed to give maximum efficiency in towing at 260 revolutions per minute.

An auxiliary donkey pump is fitted for filling the boiler when the main engine is not running, and the bilge can be drawn off by an auxiliary hand deck pump from all five compartments of the vessel. The towing gear consists of a strong hand-slip hook mounted on a well-stayed oak post.

The vessel is arranged with roomy cabins under the deck forward and aft. The boiler room is covered with a steel casing, and both engine and boiler rooms are ventilated by two large cowls. It is claimed that the vessel is a good sea boat and that under ordinary conditions a speed of about 12 miles is attained.

A second type of boat built by the same firm is a twin

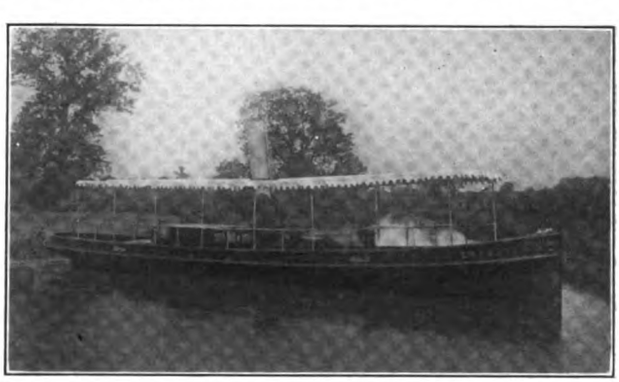


Fig. 2.—Twin-Screw Launch Tug

screw steel launch tug, as shown in Fig. 2. This vessel is 60 feet long, 11 feet wide and has a draft of 3 feet. Each propeller is driven by a separate compound engine exhausting into a separate condensing plant. This small plant is placed central in the boat just aft of the main

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engines, and is so arranged that the deck covers it, thereby allowing extra deck space for cargo. The pumps are driven by a small compound steam condensing engine having cylinders 3½ and 7½ inches diameter and 5 inches stroke. Steam is supplied by a return tubular boiler of the marine type.

There are several methods used in arranging the accommodations of this vessel, according to the requirements. That shown in the illustration consists of flush decks, for the accommodation of the crew, with cargo spaces beneath and the towing gear fitted aft of the engine room, although other arrangements can be made, if desired.

Stern-Wheel Boats vs. Screw-Propeller Barges for Shallow River Navigation

BY H. S. KEALHOFER

The economical and profitable handling of traffic on the shallow, inland waterways of the South has been a perplexing question to river-transportation people and marine engineers for some time, and especially since so many of the inland navigable waterways have been paralleled by rail lines which are willing to handle traffic between water competitive points on a basis that would be unprofitable to the river transportation lines.

There are numerous questions that enter into the cost of successfully conducting river transportation which must be solved in such a manner as to render to the patrons of such transportation the maximum amount of service, at a cost lower than rail transportation with its modern facilities, in order that the business can be profitable to the operators of such water lines and satisfactory to their patrons, but this article will treat only of the comparison of equipment used for such purposes.

The Old-Time Steamboat or "Packet" Business

Before the present development of rail transportation, and the building of rail lines which came in contact with every principal water or river point, the old-time steamboat or "packet" business was conducted on a large and profitable scale and at a cost to the shipper which was most satisfactory. The development of this water business on the rivers of the South caused such competition between the water carriers that the highest class stern-wheel and side-wheel boats were developed for this service, and marine engineers vied with each other in the construction of boats that could navigate the shallowest streams and at the same time carry an enormous amount of freight on low draft at the greatest speed that could be obtained. The result of all this competition was the perfection of the light-draft, powerful and swift steamer, equipped to move rapidly in a good depth of water, to negotiate very shallow streams and short bends, and to overcome the various obstructions that always made successful inland navigation so difficult and hazardous. The applied principle of these light-draft boats is hard to understand except by those who have had actual experience or observation of their operation on the rivers of the South, and a simple explanation of the advantages of the stern-wheel boat might be of interest to those who have never been able to see a clear demonstration of their work, and who only have an opportunity to see such boats tied up at a city wharf, or plodding along in a deep, long stretch or "reach" of water.

Advantages of the Stern-Wheel Steamboat

The writer has made numerous trips over the principal rivers of the South—between such points as New Orleans and Cincinnati, Memphis and Little Rock, Wetumpka, Ala., and Mobile, Ala.; Savannah and Augusta, Ga.,—and has made investigations of numerous other streams looking into the feasibility of their successful navigation. He, therefore, speaks from actual experience and observation. The principal obstacle to such navigation is low water, which, as expressed by the deck hand, "makes the bottom of the river too near the top." The negotiation of these shallow places has been the most frequent and expensive trouble. It was the main thing to be overcome by the marine engineers, and has resulted in a remarkable development of steamboats for shallow streams. Another obstacle is the rapid rise and fall of the inland rivers, especially those which depend upon rain for their volume of water and are not supplied by reservoirs or an extra flow of water at their source from large lakes or springs. It is a notable fact that a boat has been loaded down to the guards with freight with every indication of a good river, and before it could reach some of the more shallow places the water had run out with such rapidity that it had fallen from one to eight feet. Such a boat was confronted with the necessity of getting over, or by, the long reefs or sand bars which were thus brought into evidence. In some instances they could hug the bank on the deep side and work around the point of the bar, which generally extended out to a short bend in the river—the bend being generally one of the causes of the formation of the bar. Now, to work around one of these points, or "bites," it is necessary for the boat to go backwards and forwards in a see-saw manner to keep in the deepest part of the water and within the very narrow, circular channel that had been caused by the extension of the bar and the lowering of the water. In working around these corners the boat frequently rubs the bottom and sometimes gets fast on it.

Now comes the exemplification of the advantages of the flat-bottom, stern-wheel boat over any other kind of river craft that might be placed in a similar situation. Few people seem to realize that when a boat is resting on a sand bottom in 24 inches of water the stern-wheel can be worked backward with sufficient rapidity to force water under the bottom of the boat and actually raise it 6 to 10 inches from the bottom. At the same time, this maneuver so cuts the sand or mud that the actual force of the stream will wash out a channel. By repeated force of this kind such a craft is able to get over shallow places which would otherwise prove an impassable barrier. Another principle of the shallow-draft, stern-wheel boat is that the force of the wheel beating down against the water raises the stern of the boat and pushes ahead so rapidly that the force of the bow against the water actually raises the head out of the stream so that the boat, while drawing 24 inches of water loaded, can actually travel on water 16 to 20 inches deep when under full headway. Of course, the power of these boats could not be obtained without high-class machinery and boilers with good steam capacity, and it was one of the problems of marine engineers to so construct and distribute the weight of such machinery and boilers as to keep the boat on an even keel and at the same time have very little effect upon the trim of the boat when fully loaded with freight. Another feature of the stern-wheel boat is the fact that the machinery and everything connected therewith is above water, and in case any of the buckets of the wheels are broken, or any other damage is done to them, they can be readily repaired without much difficulty.

It is true that our Government has been spending large sums of money for deepening inland waterways, building jetties, removing obstructions and otherwise clearing

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shallow streams for navigation, but the public little realizes the vast amount of work that has yet to be accomplished to perfect a large number of rivers so that they will be available all the year for continuous navigation with a fixed minimum of depth at extreme low water.

IMPORTANCE OF THE BARGE AND TOWBOAT

Until these obstacles can be fully overcome by the Government it can be briefly stated that the best and most economical way to utilize such rivers is by the use of large covered barges to be handled by small, powerful, light-draft towboats. The towboats will not carry any freight, and, as the barges will not be burdened with machinery or heavy superstructure, they could carry three times as much freight on 24 inches of water as the ordinary stern-wheel steamboat could carry on 30 inches; therefore, one towboat with a fleet of six barges could do more work than an equal number of steamboats and at a minimum cost, approximating the operation of one steamboat. It would be expected that the towboat would be continuously moving with at least two loaded barges between terminals, and while it is enroute with two barges, two at either end of the line will be loaded or unloaded and ready for handling immediately on the arrival of the towboat, which will release its tow of two barges and pick up the two loaded barges for return movement. Instead of the expense of a crew for about six boats and their enforced idleness while being unloaded and loaded, there would be an expense of only one crew on one boat, which would be constantly moving, and the barges could be loaded and unloaded with labor that would be paid only for the work actually performed; this would also obviate the necessity of carrying on each trip a large deck crew, which has to be paid good wages and fed while en route. This method would apply principally to large traffic between regular points.

Within the past few years some enterprising marine engineers have suggested, and they have endeavored to demonstrate, self-propelled steel barges as a solution of the present expensive method of handling freight on shallow-draft, stern-wheel steamers. These barges have been operated successfully in Europe in slack water, deep streams and canals, which do not present the hazards of the inland waterways of the South. In Europe they do not have to counteract the swift-changing currents, sand bars, extremely short turns and other obstacles which are in every stream of the South.

SELF-PROPELLED BARGES

The Alabama & New Orleans Transportation Company has constructed some very large steel barges to be propelled by twin screws with a maximum of 150 horsepower, whereas the horsepower of the stern-wheel boat is from 300 to 450. The well-known principle for the successful operation of screw-propeller boats is that deep water is necessary to secure power, and the deeper the stern is set by the working of these propellers, the higher is the head of the boat out of water. Anyone can observe this by watching a motor boat moving on the water at a fair rate of speed. The barges in question were constructed for movement through the Lake Borgne Canal, Mississippi Sound, Mobile Bay and up the Mobile, Tombigbee and Warrior Rivers. The United States Government has recently completed about thirteen locks and dams on the Tombigbee and Warrior Rivers with a minimum depth of about 6 feet. These locks and dams afford practically slack-water navigation, and, as the fixed minimum depth is sufficient, there should be very little trouble in operating such barges between the head waters of the Warrior and the Mississippi Rivers via the route indicated. This is the only waterway in the South upon which such barges might be profitably demonstrated, and the writer understands that with all of these favorable conditions the operation of such barges has not been entirely successful.

The question for consideration, therefore, resolves itself into: "How could these self-propelled barges be operated on rivers which have not been locked and dammed and still offer the impediments of swift currents, sand bars, short turns, rocky banks, projecting timber and other numerous obstructions?" If these self-propelled barges can overcome the difficulties that are now confronting the light-draft, powerful, stern-wheel boats, an economical and profitable operation will be assured for shallow-water navigation. But it must first be demonstrated that they can negotiate the "bites," or short turns around sand reefs, and that they are capable of getting off the bottom, as can the stern-wheel boats, with their powerful wheels and balanced rudders. The nature of self-propelled barges requires deep water, and should they land on a bar they are high and dry with their engines stopped, and they are without the same means to extricate themselves from such an awkward position as the stern-wheel boats possess.

It is the writer's opinion that the self-propelled barge is not yet the solution for successful operation on shallow rivers, chiefly because of the conditions surrounding navigation as outlined above.

Alterations to Power Plant of Stern-Wheel Towboat Advance

BY M. VON PAGENHARDT*

The stern-wheel towboat *Advance*, of the Kansas City Missouri River Navigation Company, Kansas City, Mo., entered into regular towing service on August 2, after extensive alterations had been made to its power plant. The noteworthy feature consisted of replacing a 130-horsepower steam plant by a 600-horsepower steam plant without materially increasing the draft of the boat. At the time these alterations were under contemplation it was found that all existing stern-wheel towboats of similar power displaced betwen 400 and 500 tons, and that a careful estimate of weight and trim had to be made to accomplish with a hull of 125 feet length and 25 feet width with an allowed draft of 3 feet 6 inches what boats of 140 feet to 150 feet length and 28 feet to 32 feet width accomplish with a 4-foot draft.

CALCULATION OF WEIGHTS AND DISPLACEMENT

DIMENSIONS OF VESSEL

Length from stem to transom	125 feet 00 inches
Beam, molded	25 feet 00 inches
Depth, molded	4 feet 10 inches
Sheer forward	9 inches
Sheer aft	8 inches
Draft with 100 steam-hours' fuel	3 feet 6 inches
Displacement at 3 feet 6 inches draft (block coefficient = .80)	280 tons

WEIGHTS OF VESSEL

Complete weight of hull and cabin	130 tons
Machinery and boilers	90 "
Fuel, 250 barrels, at 310 pounds	40 "
Equipment and reserve	20 "
Total	280 tons

* Naval Architect, Kansas City Missouri River Navigation Company, Kansas City, Mo.

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Actual draf: of boat with 250 barrels of oil..... 3 feet 5 inches forward
3 feet 4 inches aft

REGISTER TONNAGE

Gross tonnage, 90; net tonnage, 80.

The analysis of the weights showed that only 90 to 95 tons were available for the complete machinery and boilers, or 300 to 315 pounds per indicated horsepower, while the plants of other stern-wheel towboats of this power

Fig. 1.—Towboat *Advance*

weigh in the neighborhood of 125 to 170 tons, or 415 to 560 pounds per indicated horsepower. This weight of 125 to 170 tons is apparently divided as follows:

MACHINERY

Main engines	25 to 35 tons
Shaft and wheel	14 to 18 "
Condenser equipment	9 to 15 "
Auxiliary engines	9 to 15 "
Piping	8 to 12 "
Total	65 to 95 tons

BOILERS

Externally fired, flue, Scotch marine, Heine watertube, Bonson combination	60 to 75 tons
Total	125 to 170 tons

By a careful selection of the main and auxiliary engines and a preliminary lay-out of the plant, the weights of the *Advance* machinery were brought to 40.67 tons, or 130.4 pounds per indicated horsepower, as given below:

MACHINERY

	Pounds	Pounds per I.H.P.
Main engines, complete, including pitmans, cam motion, shipping up engines, etc.	34,440	57.6
Shaft and wheel	20,800	38.0
Condensing equipment	7,800	13.0
Auxiliary machinery	10,200	17.0
Piping	8,105	13.8
Total	81,345	139.4
	40.67 tons	

BOILERS

Two boilers, specially designed for steamboat *Advance*, of the combination type, including superheaters, breeching, stack and stack casing	94,460	157.3
	or 47.23 tons	

The accomplished result of the machinery weight of 40 tons against 65 to 95 tons of customary weight, representing a saving of at least 40 percent in weight, is of double importance in a stern-wheel boat, where the machinery is located near the stern, necessitating additional provisions for structural rigidity and the arrangement of counterbalancing weight forward. Thus a saving of weight aft represents a saving of counterbalancing weight forward, a reduction of bending moments and excessive stresses and, due to the closer proximity of engines and boilers, a saving of weight in piping.

BOILERS

The boiler plant presented a more difficult problem to solve. Here were found lacking all comparative data for a successful, light weight, high-pressure, river boat boiler. The usual boiler in these Western River boats was found to be the externally fired return flue boiler, which in its peculiar and successful adaptation to the conditions applying to Western River boats has received the epithet, the "Western River Boiler." And it must be acknowledged that the heat absorption, first in the shell, then after the proper expansion of the gases in the rear combustion chamber, in the flues, is simple and effective, the circulation of water is excellent, being both free and short, the liberating surfaces are ample on account of the wide-spaced flues. the division of steam and water takes place without interference, due to the large steam drums mounted on top of the shells connected with large pipes

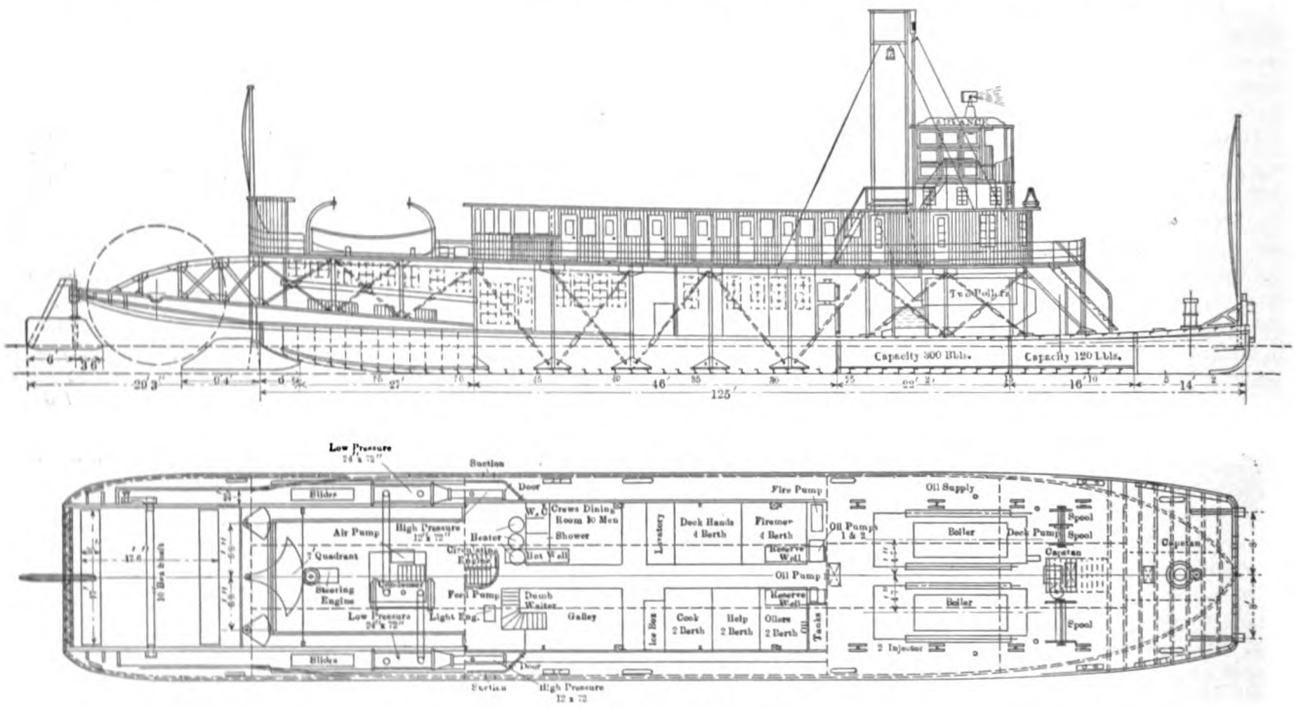

Fig. 2.—Profile and Plan of the *Advance*

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to the shell, while the mud drums allow the precipitation of mud and the feed water inlet through them facilitates the circulation. This knowledge, being hard-gained knowledge, will always be retained and will govern our selection of boiler power. The four main factors, however, guiding us in the selection of boiler power, are: Safety, service, weight and economy. In a boat with "Western River Boilers," safety is neglected altogether, service is considered only in a limited way, weight not at all, and economy only in sporadic cases.

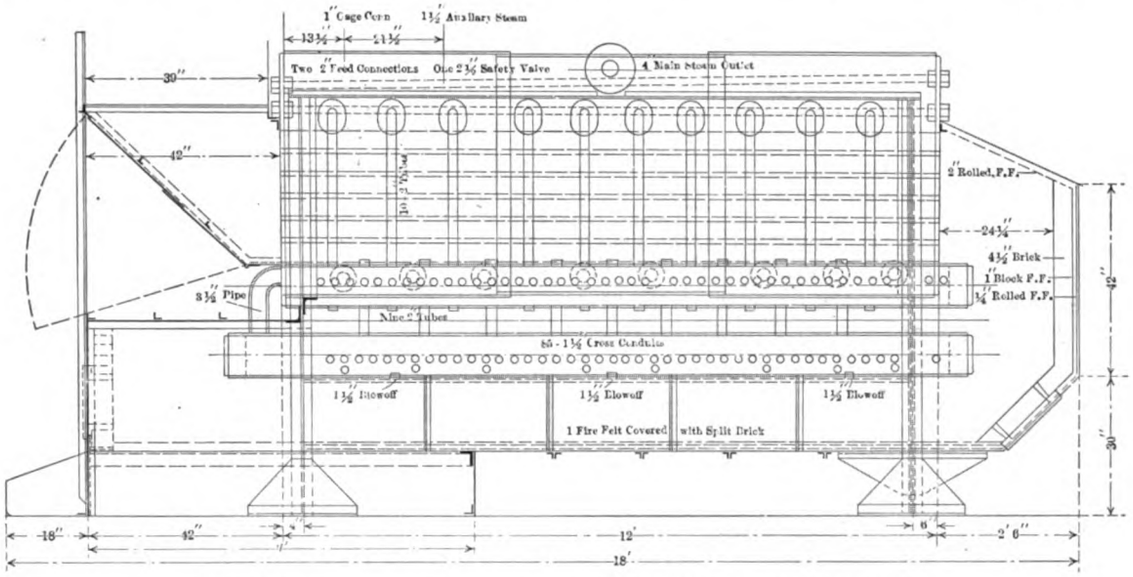

Fig. 3.—Oil-Burning Boiler, with Dutch Oven Furnace, for Towboat *Advance*

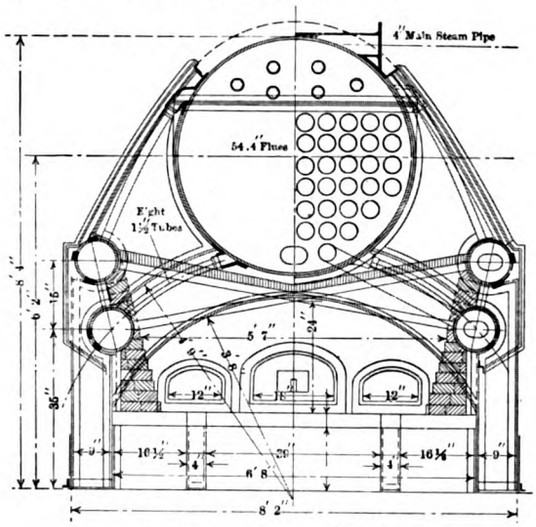

Fig. 4.—End View of Boiler

Of the other existing boilers, one may say that the Scotch marine boiler cannot carry the required pressure or is too heavy carrying the pressure. The firebox boiler does not stand a severe duration test, requires too much room and is too heavy and too expensive in repair. The watertube boiler does not stand the abuse nor the fluctuations of load nor the dirty water, and there are a number of combination fire and watertube boilers appearing and disappearing on the market, of which only a few are left at present—the Bonson boiler, the Hawkes boiler and one other that has appeared more recently, the Kidney boiler. It is a variation of this Kidney boiler that has been designed especially for the steamboat *Advance*, embodying the best features of the watertube and firetube types.

These two boilers, particulars of which are given below, have surpassed even the keenest expectations. They were designed especially for burning oil fuel and were guaranteed to evaporate 16 pounds of water per pound of oil, which they surpassed by almost half a pound, establishing a boiler efficiency of 83 percent.

Their complete weight is 42,655 pounds or 250 pounds per boiler horsepower (34½ pounds), or, figuring at 20 pounds per indicated horsepower, 140 pounds per indicated horsepower, while in the report of the United States engineers on experimental towboats, March 24, 1914, the weight of flue boilers is given as 186 pounds per indicated horsepower, of Scotch boilers as 200 pounds per indicated horsepower, of B. & W. semi-marine watertube and Bonson combination boilers as 163 pounds per indicated horsepower, and of the Ward straight-tube watertube boiler as 91 pounds per indicated horsepower.

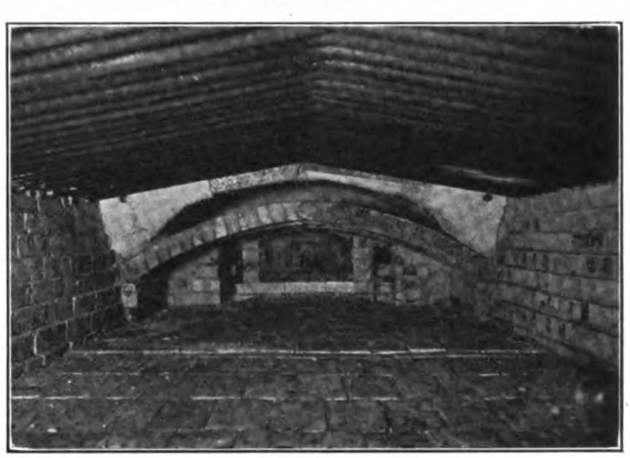

Fig. 5.—Interior of Furnace

DETAILED WEIGTHS OF BOILERS

Weight of shell, drums and tubes	15,075	pounds
Weight of sheet-iron work	5,800	"
Weight of insulation	7,840	"
Weight of air furnace	2,750	"
Weight of valves and fittings	390	"
Weight of water	10,800	"
	42,655	pounds

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Weight of superheater (128 feet)	1,450 pounds
Total	44,105 pounds

These two boilers require a space of 17 feet 6 inches in width, 18 feet length and 8 feet 6 inches height with the necessary length of room forward and aft of the boiler as required by law and convenience. The arrangement of tubes is such that every tube can be inspected and cleaned from the outside, and replaced if necessary; the construction has due regard for utmost flexibility of all parts taking care of expansion and contraction, the fire-tubes are welded into both front and rear heads; the exterior down-flow tubes are welded into the front heads and lower drums, while particular care is given to a light and durable insulation.

Special mention is made of the introduction of a Dutch oven particularly adapted for burning oil fuel, and the arrangement of a superheater in the smoke box or breeching, resulting in a superheat of 70 to 75 degrees.

HULL

The hull is of Siemens Martin steel one-fourth inch thick, built in 1907 by the Dubuque Boat & Boiler Works, Dubuque, Iowa, having wooden deck beams and a wooden deck. There were three watertight cross bulkheads, at 14 feet, 52 feet and 98 feet from the bow, separating the hull into four compartments. An additional watertight cross bulkhead 30 feet from the bow was added, creating two compartments for carrying fuel oil, and a longitudinal wooden center bulkhead was built for the length of these compartments to reduce the free moment of inertia of the oil surface by three-fourths. A steel deck of 3/16-inch thickness and steel deck beams were laid extending from the bow to the after end of the fuel oil compartments, 52 feet from the bow, while it was laid for the remainder of the deck surface only where locally required.

The providing of sufficient strength and rigidity for the additional stresses to be expected in this vessel with new machinery of four times the power of the old machinery required an increase of strength of the midship section. One could not be satisfied with the stretching of tie rods or "hog chains" over the endangered zone, as customary in Western stern-wheel towboats; these "hog chains" provide only for strength in one direction, against hogging, and can only be laid out for one load condition, the boiler weight forward, the engine and stern-wheel aft, etc., but where the trim of the vessel changes according to the weight and location of the bunker oil, and where, further, the dynamic stresses developed by the working of the wheel and the grounding of the boat exceed the static stresses of the weights, these "hog chains" are insufficient. Therefore, two solid steel trusses, similar to bridge trusses, were built into the hull, 9 feet from the center of the boat, 13 feet 6 inches high, extending over the whole length of the boat, forming in their after end a foundation for the main engines, and terminating in a graceful curve as stern-wheel supports. These trusses, weighing 14 tons, are not heavier than the customary construction of heavy cylinder timbers and "hog chain" braces; they remove one of the most serious objections to and faults of the stern-wheel type of power boat, the lack of longitudinal strength, and beautify an otherwise unsightly feature by substituting a low, graceful and for the greatest part invisible steel truss for a mass of diverging, towering braces and double sets of steel rods.

The construction proved its valuable claims at the launching of the completed vessel, where it so happened that the boat was supported at only two points and did not show any deflection. The construction has since established its rightful claims for absolute rigidity in numerous instances.

MAIN MACHINERY

The main machinery is of the Marietta Manufacturing Company, Marietta, Ohio, make, known as the McConnell steamboat engine of the tandem compound type, with the diameter of high-pressure cylinders 12 inches, diameter of low-pressure cylinders 24 inches, and common stroke 72 inches. The test showed an efficiency of 20 to 23 pounds of steam per indicated horsepower, with a piston speed of 270 to 300 feet per minute and a weight of 57 to 60 pounds per indicated horsepower. The 22-foot pitman is built of hard specification long leaf yellow pine and is the first of its kind designed in two halves, with a center steel partition for additional lateral strength.

The shaft is of hammered hexagon iron, 10 inches over the flat, with forged steel cranks, nickle steel wrist pins and forged steel collars, made by the Cleveland City Forge Company, while the four flanges are of an exceedingly light and strong design, made of cast steel having a tensile strength of 68,000 pounds per square inch, in all weighing 11,408 pounds or 19 pounds per indicated horsepower.

The stern wheel is of a radial type, which was preferred to the feathering bucket type after a careful comparison of their respective advantages under the particular working conditions of the boat. It is built entirely of wood, the arms, wheel circles, wedges and buckets being of selected oak and all braces and fillers of selected cypress. The diameter over the buckets is 17 feet 6 inches, over the arms 18 feet. The length of the buckets is 17 feet, the width 30 inches and the number of arms 12. The total weight, including stirrups, bolts and plates, is 9,380 pounds, or 15.6 pounds per indicated horsepower.

The condensing equipment consists of a circular steel shell surface condenser of 800 square feet cooling surface located opposite the low-pressure cylinders, allowing the shortest possible exhaust conduits; an air pump of the Blake Knowles make 6 inches by 12 inches by 8 inches, and a circulating pump of the Worthington make, C-5 volute, operated by a 5-inch by 5-inch A. B. Company engine, the aggregate weighing 7,800 pounds, or 13 pounds per indicated horsepower.

AUXILIARY MACHINERY

The auxiliary machinery has been reduced to the minimum, consisting of a main feed pump of the Blake Knowles horizontal duplex double-acting type 7¼ inches by 4 inches by 6 inches, an injector for auxiliary feed, a heater of the Griscom-Russell make, two additional heaters for make-up feed water, one hot well, one fire pump, one service pump, three oil pumps with heaters, an electric light engine of 7 kilowatt capacity of the General Electric Company make and a steering engine 4 inches by 4 inches of the Forbes make, the total weight being 10,200 pounds, or 17 pounds per indicated horsepower.

The main steam pipe is of 4-inch diameter, extra heavy pipe, with all valves and fittings of ferro steel for 250 pounds steam pressure, with seats of brass, with the exception of the throttle valve and seat, which is of nickle steel. The branch pipes are of 3½-inch diameter extra heavy pipe, while the auxiliary steam line is of 1½-inch diameter standard pipe. The total weight of the piping is 8,105 pounds, or 13.8 pounds per indicated horsepower.

There is a single stack of 48 inches diameter, with breeching and casing. The extreme height above the grates is 38 feet, a division plate extending clear to the top. Altogether the stack and breeching weighs 6,000 pounds, or 10 pounds per indicated horsepower.

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The equipment, such as capstan and capstan engine, which is a 6-inch by 7-inch engine of the Marietta Manufacturing Company make, the water tanks, cable, anchor and lines, weighs 26,600 pounds, or 44.3 pounds per indicated horsepower.

OPERATION

On her trial trip the boat pushed a barge 200 feet by 36 feet, loaded to a draft of 3½ feet, at a speed of 5 miles per hour against a current of 4 miles per hour, the wheel turning 22 revolutions per minute. On a consecutive trip she pushed a barge 156 feet by 30 feet, loaded to a draft of 3½ feet, at a speed of 6¾ miles per hour against a current of 4 miles per hour, the wheel turning 24 revolutions per minute.

The World's Largest Ferry Steamer

Of unusual interest to the marine engineering world is the new train ferry *Contra Costa,* which is nearing completion at Oakland, Cal. This vessel will be the largest ferryboat ever built and represents the latest ideas in the design of ferry steamers, which incidentally have reached a remarkably high stage of development on San Francisco Bay.

The *Contra Costa* is being constructed by the Southern Pacific Railroad and will be used by them to carry passenger and freight trains across Carquinez Straits, between Port Costa and Benicia, Cal. She will supplement the ferryboat *Solano,* which for many years has held the reputation of being the world's largest ferry. The new vessel is built of Oregon pine throughout, 2,000,000 board feet of lumber being used in her construction. In order to insure against end or side collision fourteen watertight bulkheads have been provided. Any one of these bulkheads might be punctured without endangering the vessel. The design of the *Contra Costa* called for some exceedingly large timbers, and it is of interest to note that there are single timbers in the hull measuring 26 by 36 inches by 66 feet long, and others 116 feet in length by 18 inches square.

The principal dimensions of this vessel are as follows: Length overall, 433 feet; length over transoms, 420 feet;

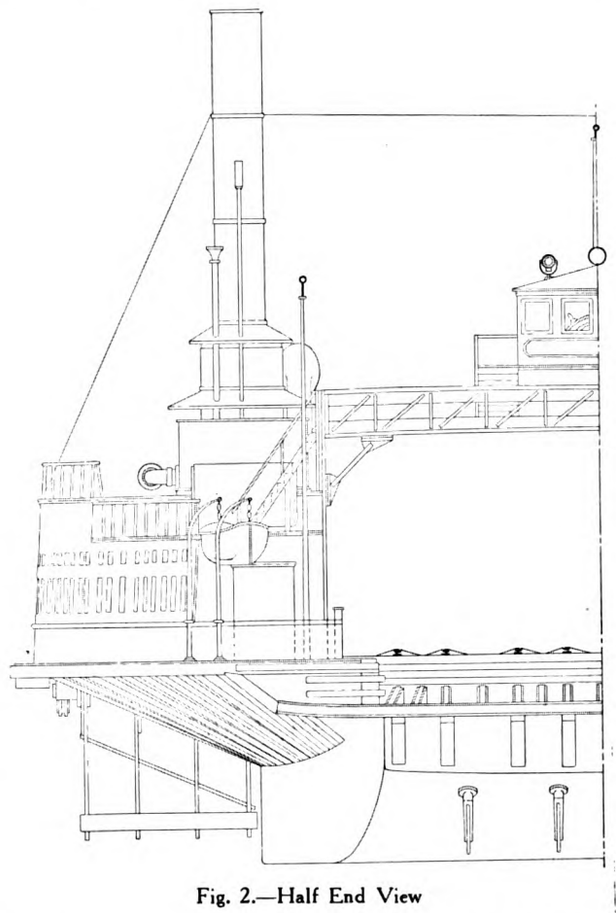

Fig. 2.—Half End View

width over guards, 116 feet; beam, molded, 66 feet; depth (amidships), 19¾ feet; draft, light, 5 feet; draft, loaded, 6 feet to 7 feet.

The four tracks on the main deck will accommodate thirty-six freight cars and two locomotives or twenty-four passenger cars and two locomotives.

In order to provide a maximum amount of track space the propelling machinery has been placed below the level

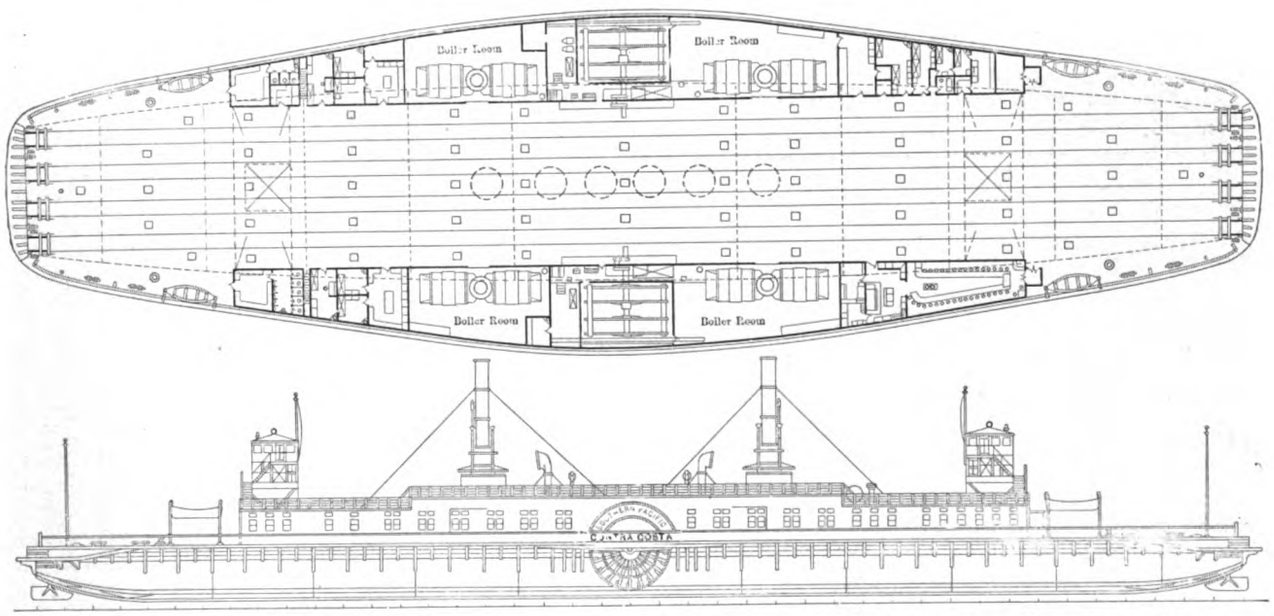

Fig. 1.—Car Ferry *Contra Costa,* Built by the Southern Pacific Railroad and Said to Be the Largest Car Ferry in the World

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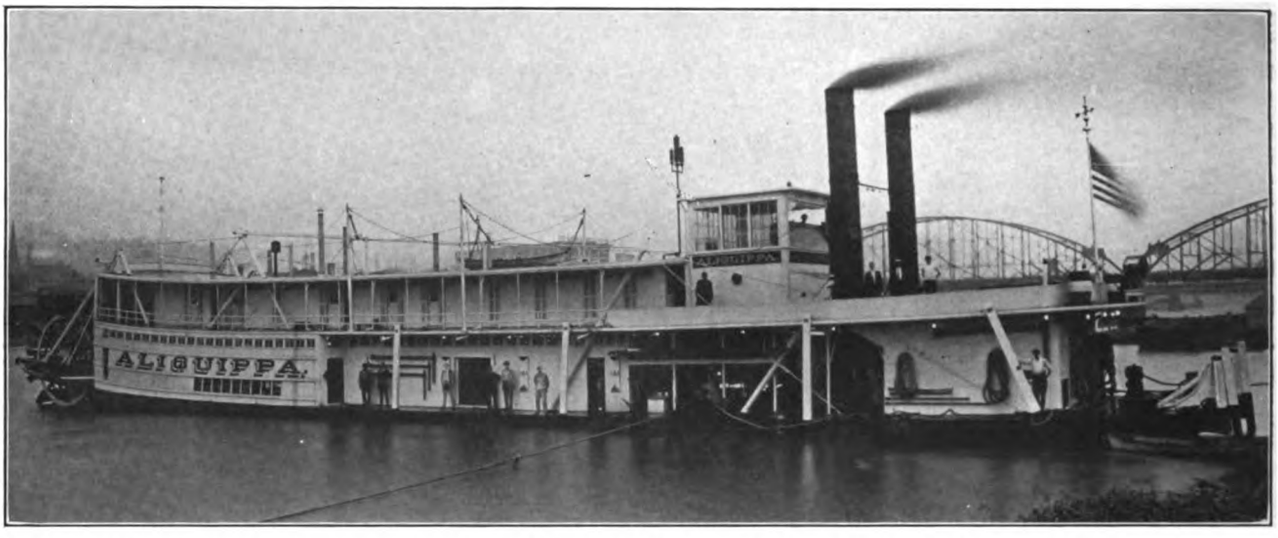
of the main deck. There are two separate engines of 2,500 horsepower, one located on either side of the vessel. This arrangement permits the independent operation of the two paddle wheels, so that in case of emergency the vessel may be maneuvered by reversing one wheel and sending the other ahead. The engines are of the low-pressure condensing type, equipped with Corliss valve gear, and set on an inclined engine frame. They were built at the railroad shops at Sacramento, Cal.

Steam will be supplied at a pressure of 60 pounds per square inch by eight Scotch dry back boilers, located on the main deck. Fuel oil is to be used under the boilers, the burners being supplied from two tanks of 7,800 gallons capacity, located below decks. Four water tanks of approximately 8,000 gallons capacity will supply water to the boilers and will also be utilized for filling locomotive tanks while crossing.

For the accommodation of local passengers a waiting-room, restaurant and bar have been provided in the superstructure. A small generating set will supply electric current for lighting purposes, and also for searchlights on either end of the boat.



Stern-Wheel Towboat *Aliquippa*, Built by James Rees & Sons Company, Pittsburg, Pa., for the Jones & Laughlin Steel Company

Fireproof Towboat Aliquippa

James Rees & Sons Company, Pittsburg, Pa., has recently completed for the Jones & Laughlin Steel Company, Pittsburg, a fireproof stern-wheel towboat, 153 feet long on the deck and 29 feet beam, with a 5-foot depth of hold, driven by tandem compound engines, 14 inches and 28 inches diameter by 7 feet stroke, fitted with lever balance poppet valves, with the Rees inside cam motion taken from the connecting rod and the Rees adjustable cut-off motion taken from the crosshead. The engines drive a paddle wheel 21 feet diameter with buckets 20 feet long and 36 inches wide, the average number of revolutions in heavy tow being 18. A cylindrical surface condenser with Warren air pump and circulating pump is fitted. The boiler is fed by a "doctor" pump through a feed water heater equipped with a brass pipe worm, which delivers the water to the boiler at a temperature of 200 degrees Fahrenheit. The other auxiliaries include a steam power capstan driven by a double 6-inch by 9-inch engine and a General Electric turbo-generating set.

The hull is divided into twenty-one watertight compartments by three longitudinal bulkheads 3/16-inch thick, and five transverse bulkheads secured to the bottom and deck plating by flanged intercostals. The frames throughout are 2½-inch by 3-inch by ⅜-inch angles spaced 18 inches apart, while the deck beams are 3-inch by 2-inch by ⅜-inch angles spaced on every frame. The deck is of ¼-inch steel plate, while under the boiler and coal box the deck is covered with 2 inches of concrete. The side bulkheads and framing for the cabin on the main and boiler decks is built entirely of steel plate and angles. The pilot house is also of steel, the balance of the cabin being of wood construction with panels of "Nevasplit" furnished by the Keyes Products Company, of New York, which by treatment are rendered non-inflammable. The boiler deck forward is made of plates and angles, the side rail and stanchions of galvanized pipe, and the inside of the cabin overhead of steel plate in order to make the cabin as fireproof as possible without building it entirely of steel.

Besides being practically fireproof, the boat has proved a great success in steering, especially in a river with strong current and dangerous bends. In light condition the boat is practically on an even keel, a feature which is very desirable for river craft which have to cope with low water conditions.

Hydraulic Suction Dredge No. 103

The hull of a wooden 18-inch hydraulic suction dredge, 100 feet long, 40 feet beam and 8 feet depth, having two decks and an operating room on top, contracted for by the Jennings Pump & Dredge Company, Chicago, Ill., is now at the docks of the Marine Iron Works, Chicago, for the installation of her boilers and machinery, which were built by this company. There are four boilers, each 90 inches diameter by 144 inches long, with single furnaces 44 inches diameter, built according to the Hartford Inspection Rules, for a steam pressure of 175 pounds per square inch. The battery of four boilers, which is installed on the main deck, is supplied with feed water by two Worthington ram pattern pumps, each 7½ inches by 5 inches by 6 inches.

The machinery consists of a triple expansion engine with cylinders 13½ inches, 19 inches and 33 inches diameter by 16 inches stroke, connected with an 18-inch Jennings hydraulic suction pump supplied by the Jennings Pump & Dredge Company. Both the engine and pump

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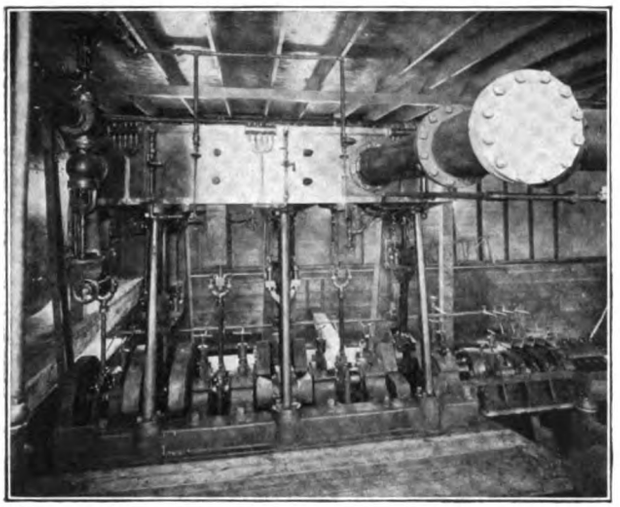

Fig. 1.—Pumping Engine

are securely fastened to a structural foundation, which in turn is bolted to a series of four longitudinal and four athwartship bulkheads, running the entire length and width of the hull, and of very substantial construction, so that when the tests of the machinery were made the hull showed an entire absence of vibration.

The engine room auxiliaries consist of a Worthington ram fire pump, 7½ inches by 5 inches by 6 inches, connected to the fire lines; a condenser pump of the jet type, 10 inches by 18 inches by 18 inches, supplied by the Warren Steam Pump Company, and a closed heater placed in the hold with the pumps capable of taking care of all the auxiliaries. The piping throughout is arranged according to the best marine practice.

The hoisting machine arranged for lifting the spuds and ladder and for swinging the hull is of the 5-drum type with double engines having cylinders 8 inches in diameter and 8 inches stroke, built for a full boiler pressure of 175 pounds. The ladder is of solid I-beam construction, having a steel cutter of the open type driven by a double engine 9 inches by 9 inches. The cutter shaft is of nickel steel 5 inches diameter, while the gears are of manganese steel. The A-frames for lifting the spuds,

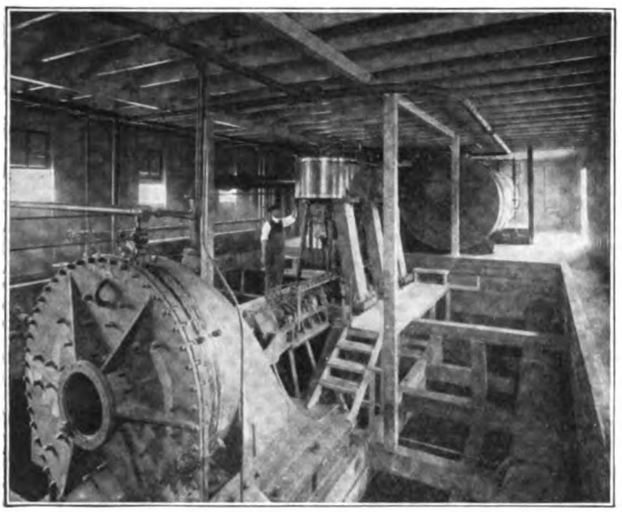

Fig. 2.—Jennings Centrifugal Pump

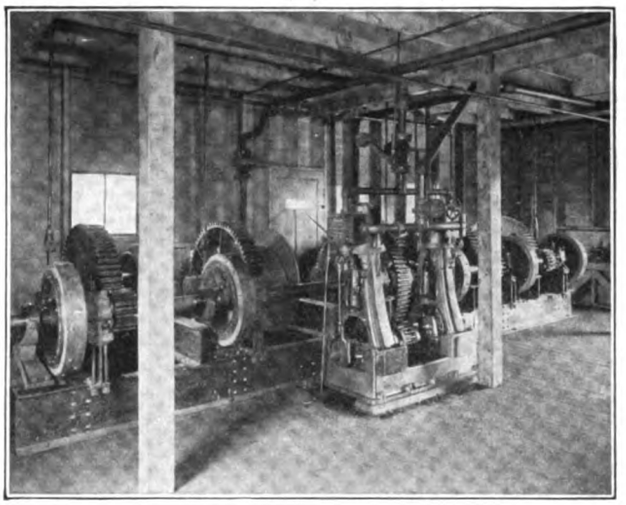

Fig. 4.—Hoisting Machinery

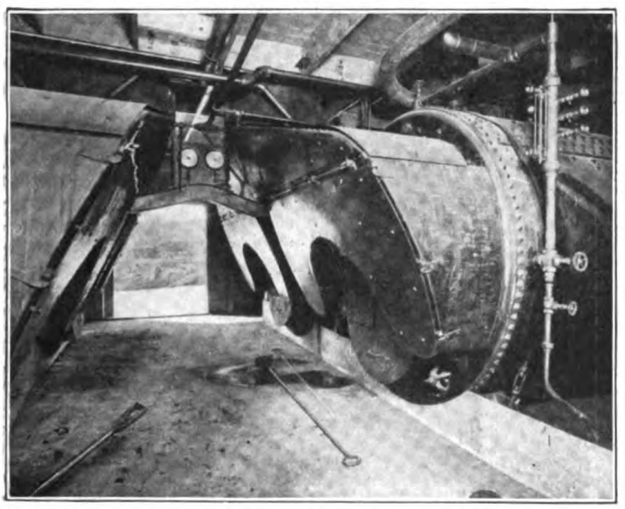

Fig. 3.—Boilers

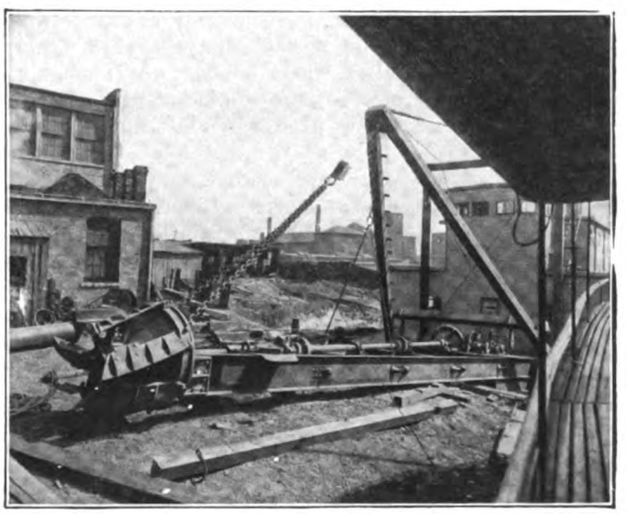

Fig. 5.—Cutter

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the ladder, and also the gantry frames, are of wood. All the hoisting machinery is arranged to be operated from the upper deck, where the usual gages, such as the recording, vacuum and steam gages, are in full view of the operator.

Devotion of a German Marine Engineer to the Machinery in His Charge

The *Pall Mall Gazette* of London, in its issue of September 11, 1914, published an article entitled "Ober-Ingenieur McAndrews," which tells of the capture of the German steamer *Kronprinzessin Cecilie*. The extract given below relates to the devotion of the German chief engineer to his machinery, and of his effort to have it cared for after he should be gone. The references will be entirely clear to all who have read Kipling's fine poem about marine machinery, entitled "McAndrews' Hymn."

"But the *Kronprinzessin* had one true heart aboard, and here comes a fine touch of humanity. After making the round of the ship our chief engineer found in the cabin assigned him a blotting pad with a farewell message. There were none of the German jeers you might expect, but penciled appeals in broken English to clean the engines 'twice weekly,' to feed the 'pidgons' on the 'upper deck,' and to 'oel' the piston-rods regularly for the very good reason that 'paking is cast iron and will be rosting.' It seems that the Ober-Ingenieur who wrote this note had superintended the building of the ship in the Stettin yards, and when he took leave of her at Falmouth they say he sobbed like a woman bereft of a child. Doubtless in the Babylonian captivity of Bodmin he wonders how the engines that he loved are faring, and it should comfort him to know that they are in good hands. Moreover, his blotting pad message now adorns a British officer's album as so much proof that a true McAndrews may bear a German name."

The New United States Revenue Cutters

In accordance with a recent act of Congress authorizing the construction of two new ships for the Revenue Cutter Service, designs were prepared by the Treasury Department for the new ships; one to be known during construction as No. 26, to replace the revenue cutter *Woodbury*, stationed at Portland, Me., and the other as No. 27, to replace the old cutter *Winona*, now stationed at Mobile, Ala. Bids were opened at the Treasury Department on September 1 for the construction of these two vessels, and the lowest bid, that of the Newport News Shipbuilding & Dry Dock Company, in the sum of $198,000 (£40,600) for each vessel, was accepted, and the contracts have been formally awarded to that concern. Both vessels are of the same size, the only difference being that the cutter for service on the coast of Maine will be especially fitted for breaking ice in the frozen harbors and thoroughfares of the Maine coast during the winter season. The vessels will be built of steel throughout and will be fitted with every modern means of rendering aid to vessels in distress, of destroying derelicts and for the the other purposes of the Revenue Cutter Service.

Each vessel will be 165 feet 6 inches long overall, 150 feet long between perpendiculars, 32 feet beam molded, with a depth of 20 feet 9 inches. Their displacement at a mean draft of 11 feet 6 inches, with 200 tons of coal, 13,000 gallons of fresh water and 12 tons of stores, will be 900 tons. They will be flush-decked and schooner-rigged. Ample and comfortable quarters for a crew of about 60 men and 8 officers will be provided.

Powerful radio apparatus will be fitted to each vessel, as that is found to be indispensable for the regular work of the Service. The equipment will also comprise five able boats, a steam steering engine, a steam windlass, steam capstans for handling towing lines, and various other auxiliaries to make them first-class revenue cutters in every respect.

The propelling machinery will consist of one triple-expansion engine 17 inches by 27 inches by 44 inches by 30 inches stroke. Under maximum conditions the indicated horsepower will be about 1,000. Steam will be furnished by two straight tube watertube boilers, working at 180 pounds steam pressure. Powerful fire pumps and wrecking siphons will be fitted to each vessel to fit them for rescue work.

Since the contract has been awarded, as it was found that there was a sufficient fund left from the original appropriation, arrangements have been made to fit the Southern vessel as an oil fuel burner. She will carry sufficient fuel oil to give her a steaming radius of over 5,000 miles. This is a necessary feature of this vessel, as she will be employed in long cruises in the Gulf of Mexico searching for derelicts.

The contract calls for these vessels to be finished within ten months, and the active work of construction has already commenced at the yards of the builders.

Remarkable Accident to Shallow Draft Steamer on South American River

The stern-wheel steamer *F. Perez Rosa*, built by James Rees & Sons Company, of Pittsburg, Pa., for service on the Magdalena River, Colombia, South America, recently met with an unusual accident in coming down the river with about 200 tons of cargo, mostly coffee, on board and towing four barges. The boat is 170 feet long on the

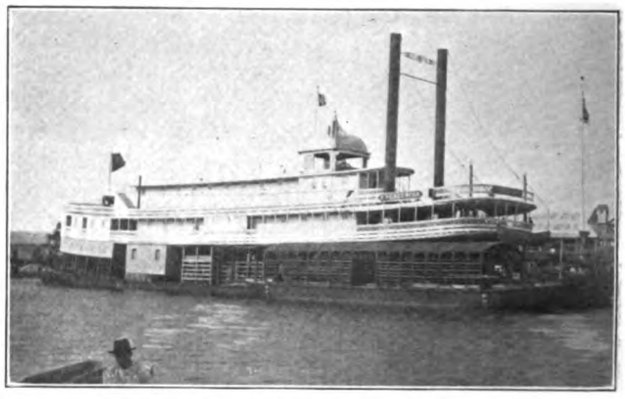

Fig. 1.—The *F. Perez Rosa*

deck, 32 feet beam, and draws 4 feet of water when loaded with 400 tons of cargo.

At the time of the accident the boat was struck on the port side about two feet below the waterline at frame No. 7 forward of the collision bulkhead by a submerged log about 5 feet in diameter. The bottom of the boat was ripped apart back to frame No. 36, tearing out the forward cross bulkheads at frames 10 and 30 and the center longitudinal bulkhead from frame 10 to frame 36. The damaged part of the hull was directly under the three boilers, which were left without support except for the deck beams. Fortunately, however, the cross bulkhead at frame 42 and the longitudinal wing bulkheads held, thus saving the boat.

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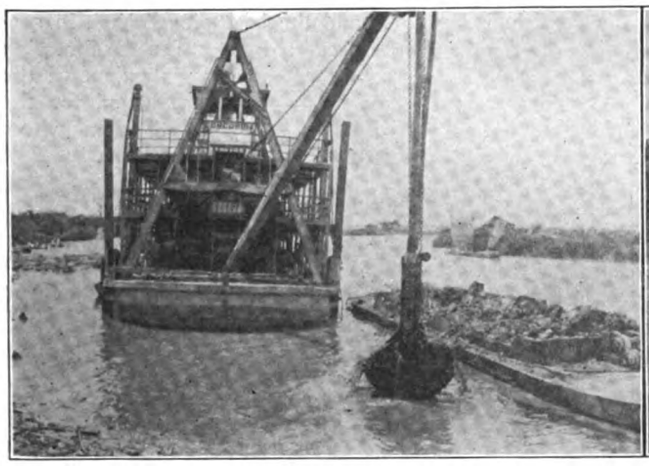

Fig. 2.—Dredging Out the "Mud Dock"

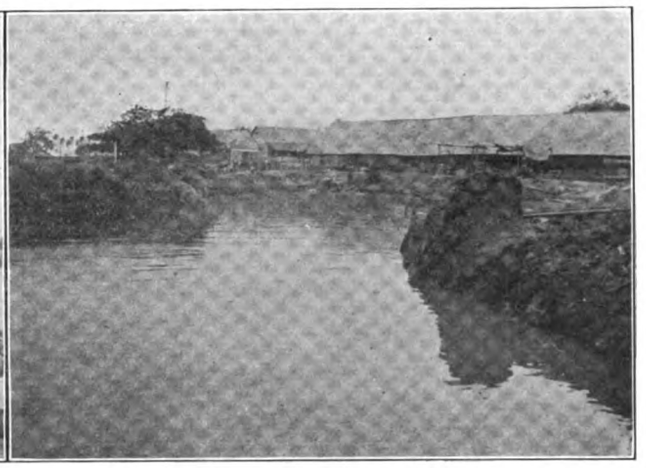

Fig. 3.—Entrance to the Pond

The cargo was thrown overboard and the boat was brought down to Barranquilla, a distance of about 500 miles, under her own steam. As no dry dock was available, a pond or mud dock was dredged out on one side of the river, and the boat was drawn into the pond, after which the dredge filled up the entrance behind the boat, and then the water was slowly pumped out. Blocks and shores were placed under the boat to enable repairs to be made. When the water was all pumped out of the mud dock, about 4 feet of soft mud was taken out, and

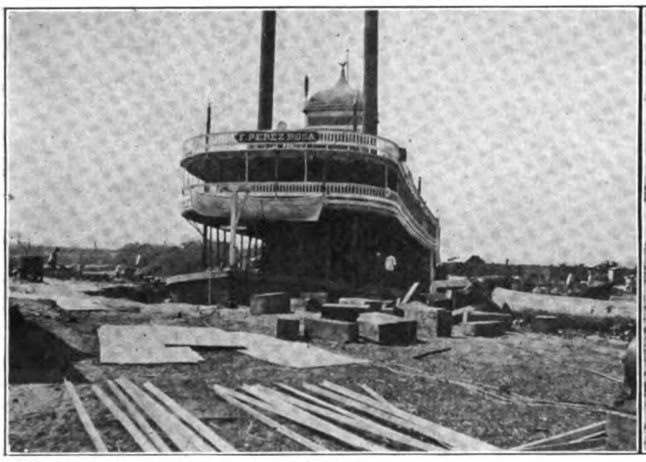

Fig. 4.—View of Boat in the "Mud Dock"

Fig. 5.—Mud Dam at Entrance to Dock

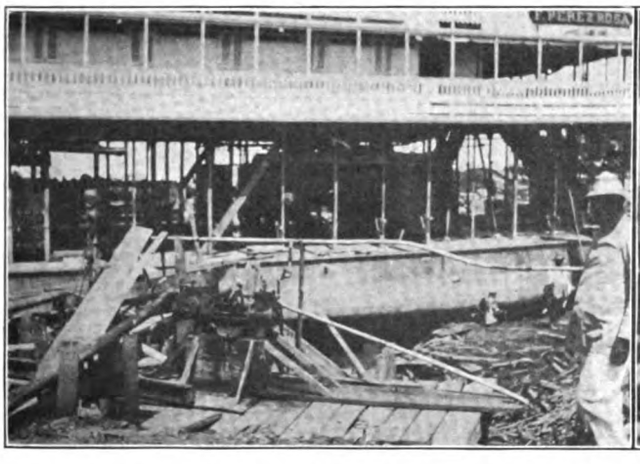

Fig. 6.—Digging Out the Mud after Pumping Out the Water

Fig. 7.—Interior of Damaged Hull, Looking Forward

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then new plates were put in. It was necessary to keep the pumps working day and night, as the ground was soft and there was a lot of seepage.

About twenty-five days were required in preparation for the repair work, and fifteen days for making the actual repairs to the hull. The work was successfully accomplished, however, and the boat placed back in service. The entire job was carried out under the direction of Captain B. L. Wooster, marine superintendent of the steamboat company, to whom we are indebted for the photographs and details given above, and from whom readers can obtain further particulars, if desired.

Stern-Wheel Steamers for South America

Two Large Passenger and Freight Boats Built by James Rees & Sons Company for Service on South American Rivers

During the last year James Rees & Sons Company, Pittsburg, Pa., delivered to South American owners for river service two large stern-wheel passenger and freight boats of the type familiar on the western rivers of the United States. The first of these, the steamer *Palmer*, is 136 feet long on the main deck, 30 feet beam and 5 feet depth of hold, with 30 inches sheer. The framing of the hull consists of 2-inch by 2½-inch by 5/16-inch angles spaced 18 inches between centers. The deck beams are 2-inch by 3-inch by 5/16-inch angles, one-third of which are spaced 18 inches between centers and the balance spaced 3 feet apart. The stem is of forged steel, 1½ inches by 8 inches, and 5 inches slotted out to receive the keel plate, to which it is secured by countersunk tap bolts. There are five transverse bulkheads, which, together with the longitudinal bulkheads, divide the hull into twenty-one watertight compartments. The shell plating is of 7.5-pound plate, while the main deck is of ⅛-inch plate. All the plating is galvanized and double riveted. The hull is further strengthened by four Z-bar keelsons, together with stanchions spaced every 6 feet.

The cabin on the boiler deck has ten rooms besides the pantry and toilets, while on the hurricane deck there is a texas with the captain's room and eight rooms for the cabin crew. The galley and storeroom are on the main deck.

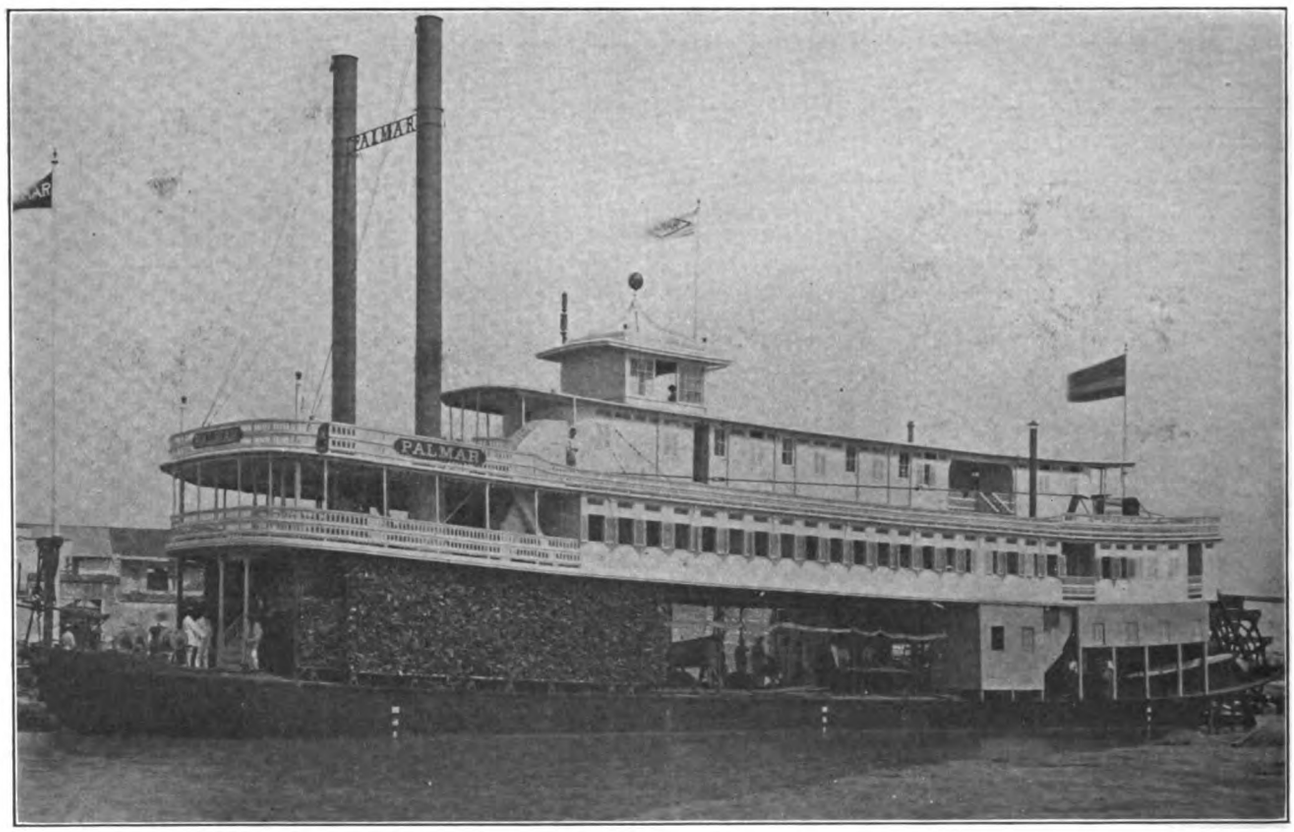

Fig. 1.—Stern-Wheel Passenger and Freight Steamer *Palmer*

Propulsion is by high-pressure engines with cylinders 14 inches in diameter, and a stroke of 6 feet, of the lever-balance poppet valve type, with inside cam motion on the connecting rod and adjustable cut-off motion from the crosshead. The stern wheel is 18 feet diameter with buckets 24 feet long and 22 inches wide. Steam is furnished at 200 pounds pressure by two horizontal tubular boilers built in accordance with the United States Steamboat Inspection Service Rules.

The second boat built for South American river service is the steamer *Bucaramanga*, 170 feet long on the main deck, 33 feet beam, and 4 feet 6 inches depth of

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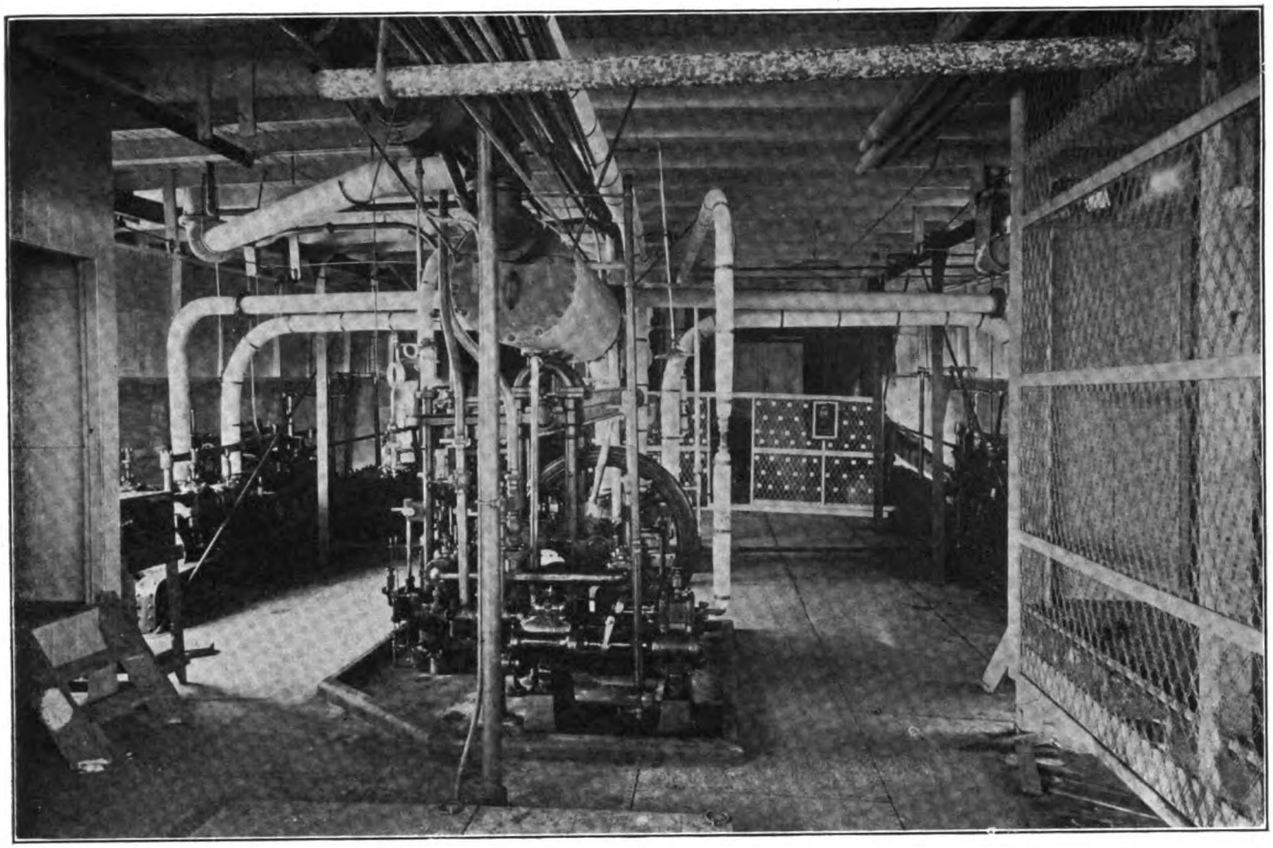

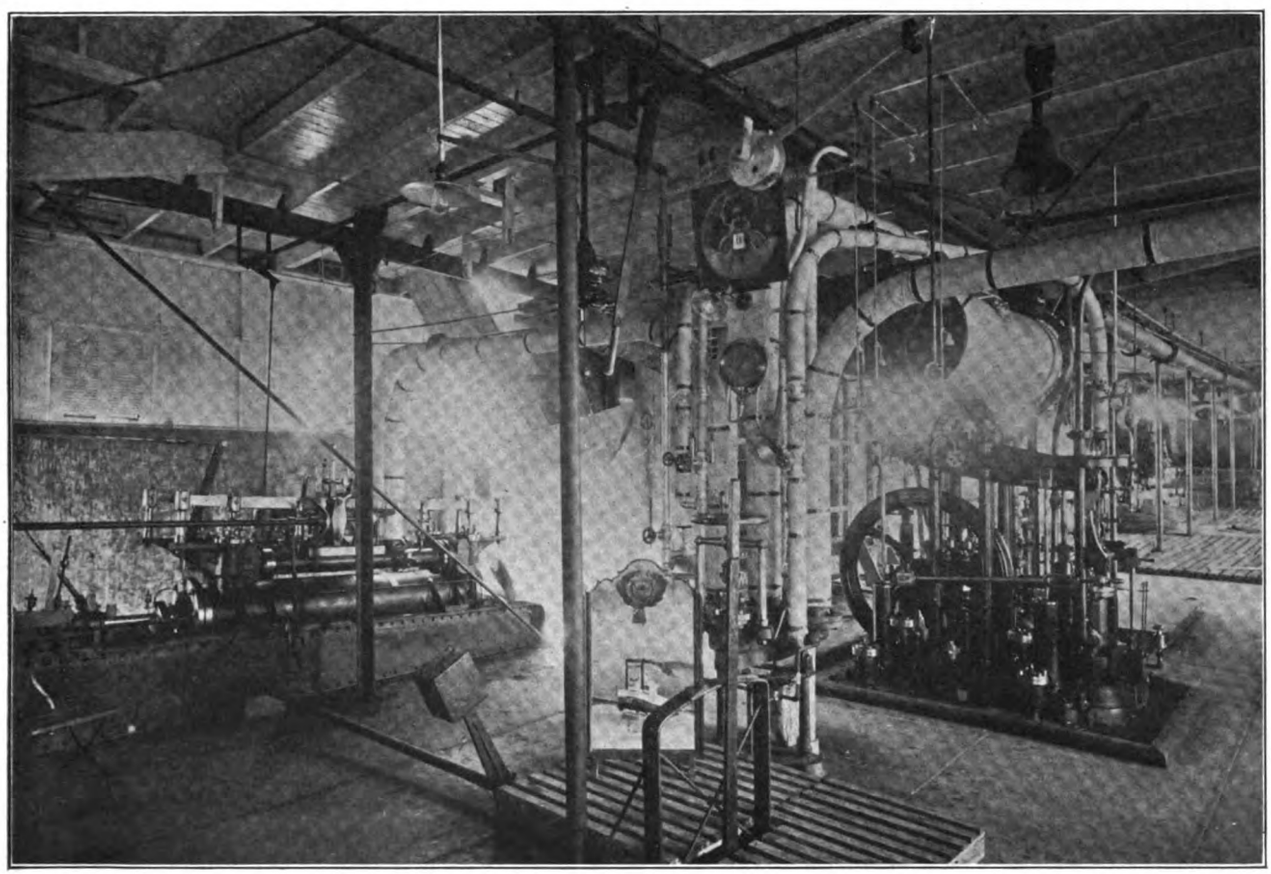

Figs. 2 and 3.—Views of the Engine Room of the Steamer *Palmer*, Showing Main Engines, "Doctor" Feed Pump and Operating Platform

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hold with 3 feet sheer forward. The hull is divided into twenty-one watertight compartments by three longitudinal bulkheads of No. 10 gage plating and three transverse bulkheads. The main deck is of 3/16-inch steel plate, both the shell plating and deck being galvanized and

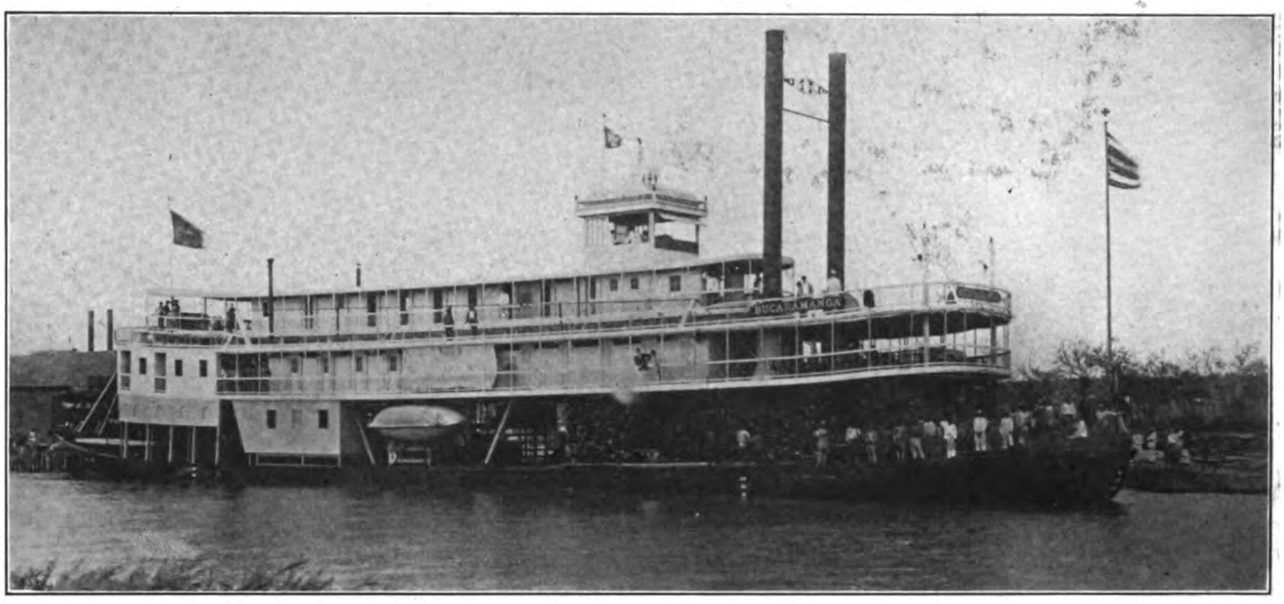

Fig. 4.—Steamer *Bucaramanga*

punched for double riveting. The framing of the hull is of 2-inch by 3-inch by 5/16-inch angles spaced 18 inches apart, and the deck beams 2-inch by 3-inch by 5/16-inch angles spaced 18 inches apart for one-half the length of the boat, the balance being spaced 3 feet apart, all of the

Fig. 5.—Main Cabin of Steamer *Palmer*

deck beams being secured to the side frames by gusset plates. Stringers of steel channels are secured to the floor frames and deck beams.

A large cabin is built on the boiler deck with rooms for passengers. while on the hurricane deck is a large texas for the crew and passengers with a pilot house on top of same. The ventilators throughout the boat are screened with bronze wire screen as a protection from mosquitoes.

The power plant consists of three tubular boilers, built for a working pressure of 200 pounds per square inch, and high-pressure engines, 16 inches in diameter, with a stroke of 6 feet, of the lever double balance poppet valve type, with the Rees inside full-stroke cam motion taken from the connecting rod and the Rees adjustable cut-off taken from the crosshead. The auxiliaries include a steam reversing jack, a "doctor" feed pump, a feed water heater, injector and the usual pumps.

After making several trips on the river, the boat has proved very successful during low water and has been able to tow four barges besides carrying freight and passengers on the boat itself.

Naval Architects' Annual Meeting

The twenty-second general meeting of the Society of Naval Architects and Marine Engineers will be held in the Engineering Societies Building, 29 West Thirty-ninth street, New York City, Thursday and Friday, December 10 and 11, and will begin at 10 A. M. each day. The annual banquet will be held in the Astor Gallery of the Waldorf-Astoria Hotel, at 7 P. M., Friday, December 11.

The following is a preliminary list of papers which have been promised, but as some of the manuscripts have not been received or passed upon by the committee on papers, a final list of papers actually to be published will be sent out before the meeting:

"International Conference on Safety at Sea," by Hon. E. T. Chamberlin.

"Some Experiments with Models Having Radical Variations of After Sections," by Naval Constructor D. W. Taylor, U. S. N.

"Expansion and Contraction of Certain Dimensions and Their Effect upon Resistance," by Professor H. C. Sadler.

Subject not yet decided upon. By Naval Constructor J. G. Tawresey, U. S. N.

"Stability of Vessels as Affected by Damage Due to Collision," by Mr. William Gatewood.

"The Application of Electric Propulsion to Battleships, together with the Experience Gained in the Jupiter," by Lieutenant S. M. Robinson, U. S. N.

"The Automatic Tension Engine, a New Marine Implement," by Mr. Spencer Miller.

"Subdivision Rules as Adopted by International Conference on Safety at Sea," by Mr. James Donald.

"The Present Status of Marine Diesel Engine Installations," by Mr. W. R. Haynie.

"The Thermodynamics of the Marine Oil Engine," by Mr. John F. Wentworth.

"The Behavior of Riveted Joints under Stresses," by Mr. James E. Howard.

"Recent Developments in Submarine Signaling," by Mr. J. B. Millet.

"Fire Protection of Ships," by Mr. W. C. Teague.

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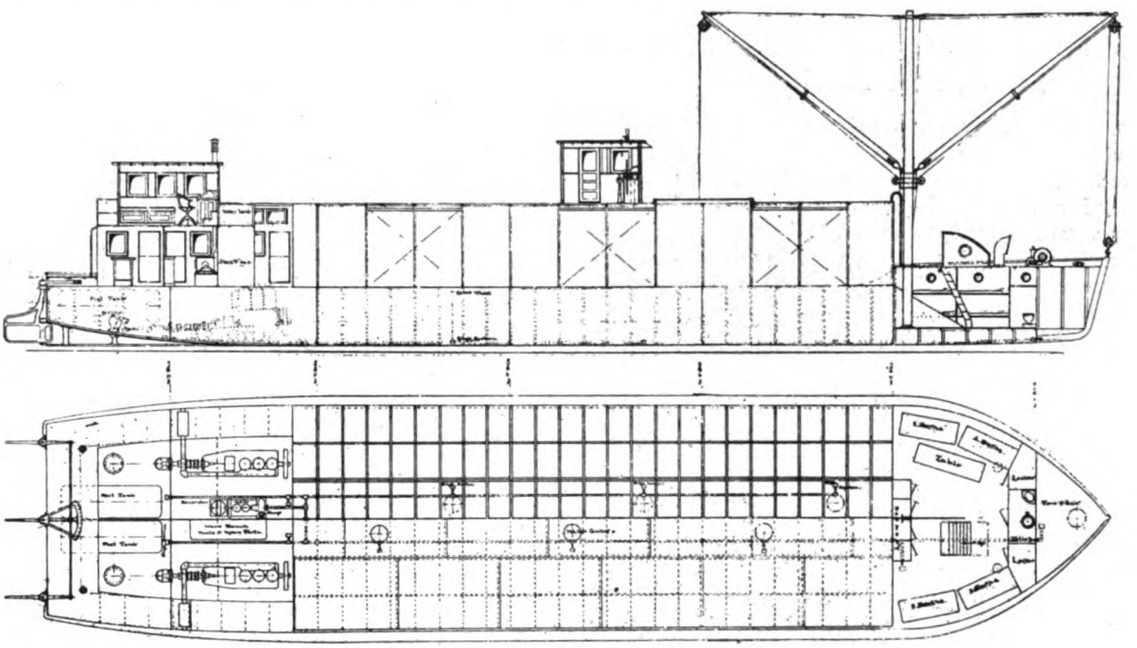
Twin-Screw, Tunnel Stern, Shallow-Draft Steel Cargo Boats for the Macon-Atlantic Navigation Company

An interesting item of much interest to those who follow the development of motor boating along commercial lines is the contract recently awarded to J. Murray Watts, of Philadelphia, Pa., by the Macon-Atlantic Navigation Company, Macon, Ga., for the designs and specifications of a fleet of ten steel cargo boats, of the twin screw, tunnel-stern type, plying on the Ocmulgee and Altamaha rivers between Macon and Brunswick, a round trip of 720 miles. These boats are propelled by two 50 horsepower oil engines and a 12 horsepower auxiliary oil engine runs the pumping plant and the generator. This generator supplies current for lighting the boat throughout, and for a 3,000 candle-power searchlight. There is, moreover, an electric winch located forward which is driven by a 10 horsepower electric motor. This winch is used for four purposes: first, for loading and unloading cargo which cannot be conveniently handled through the side doors of the freight compartment; second, by means of the forward derrick, lifting snags or other obstructions from the channel; third, warping the boat alongside of dock, and fourth, handling the anchors.

The navigation of the rivers between Macon and Brunswick is very difficult in the dry season on account of the numerous sand bars, which stop navigation for all but the lightest draft boats, and another difficulty is the fact that in the upper reaches of the river the channel makes very sudden bends, so that it has forced the old-time, stern-wheel steamers to get lines ashore and warp their way around the bends. During the rainy season there is generally plenty of water in the river, often as much as 10 to 12 feet over the worst shoals, but after a prolonged drought there is found to be only a little over 3 feet on these shoals. For this reason the company required boats which would carry a minimum of 75 tons of cotton on a draft of 30 inches and 150 tons of cotton on a draft of 45 inches.

The design of the tunnels in which the screws are located has been very carefully studied out, so that there will be no tendency to suck the stern down, even in the shoalest waters. To aid in making the sharp turns in the upper reaches of the river, each boat is equipped with three rudders, which, together with the reversing twin screw engines, give the boats ample maneuvering power.

The hulls of these vessels are built of mild steel and divided into twelve watertight compartments, each compartment being fitted with a manhole for inspection purposes and a valve wheel operating the bilge suction, so that, should the bottom be damaged by contact with a shoal, the rotary 12 horsepower bilge pump will be quickly connected up and keep the water in that compartment down until repairs can be made. This pump is also used for washing down decks and as a fire pump. It will be noted that there is a watertight athwartship bulkhead which divides the engine room into two separate compartments, so that, should one of these compartments be flooded, the boat will still have an engine to run on. Moreover, there is a bulkhead between the engine room and the after peak, so that should damage occur to the tunnel, as jamming or obstructions between the propeller blades and the tunnel walls, the water will not flow into the engine room. The fuel tanks are also placed in the after peak and protected by this watertight bulkhead from any accident or fire in the engine room.



Design of Self-Propelled, Tunnel-Stern Cargo Boat for the Macon-Atlantic Navigation Company

To obviate the danger of fire, the entire boat, including hull and house, is made of steel, the only woodwork being the captain's cabin and the pilot house.

The accommodations are unusually good for a boat of this type, there being a roomy forecastle, with bunks for eight men, with the usual lockers, toilet room, etc. Aft there is a stateroom for the captain, a toilet, a stateroom for the mate and engineer, a dining room, galley and storeroom.

JUNIOR INSTITUTION OF ENGINEERS.—The Most Hon. the Marquess of Graham, D. L., C. B., C. V. O., has been elected president of the Junior Institution of Engineers for the year 1914-1915. The Vickers prize, consisting of a gold medal and a premium of instruments or books, has been awarded to Mr. James Richardson for his paper on "High Power Diesel Engines; Their Development for Marine Service."

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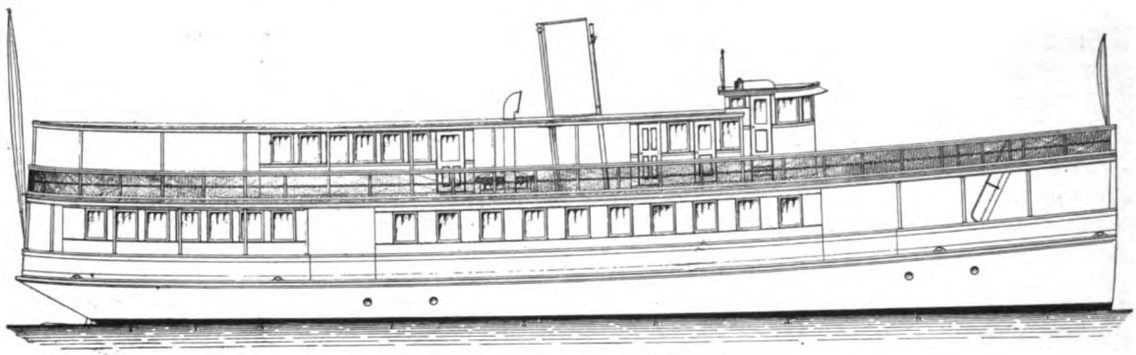

Fig. 1.—Outboard Profile of the *Dixie*

New Shallow Draft Passenger Steamer for Use in Florida

Messrs. Cox & Stevens, naval architects, New York City, have recently placed a contract with William R. Osborn & Son, of Croton-on-Hudson, N. Y., for the construction of a shallow draft combination freight and passenger vessel, named the *Dixie*, to be operated by the Kinzie Brothers Steamboat Line, Fort Myers, Fla. This line operates vessels from Fort Myers down the Caloosahatchee River to the Gulf of Mexico, a distance of eighteen miles. The boats carry passengers and farm truck and therefore require a fair rate of speed on shallow draft with ample deck space and storage room for vegetables. The principal dimensions of the *Dixie* are: Length, 100 feet; beam, outside planking, 20 feet; draft, 4 feet 2 inches.

The boat has pleasing and serviceable lines, the freeboard is moderate, the sheer ample, and the general construction and disposition of deck houses, pilot house, etc., practical and attractive.

On the main deck aft is a ladies' saloon 22 feet in length, on each side of which is a passage for handling lines, etc. Just forward of this saloon is a clear space directly across the deck, from which the companion stairs lead to the upper deck. Forward of this space, which serves as the main gangway, is a central deck house containing the machinery inclosures, galley, messroom and a separate saloon for colored passengers. The central deck house is 40 feet long, leaving a clear space forward on the main deck 27 feet long for freight. There is also a clear space for freight 5 feet wide on each side of the deck house. The hold space, both forward and aft of the machinery, is ceiled and available for the stowage of cargo.

Above the main deck there is a complete upper deck running from one end of the vessel to the other for the

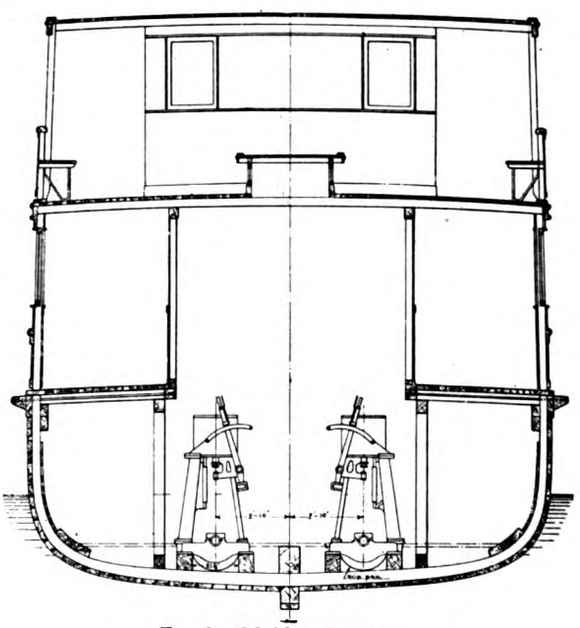

Fig. 3.—Midship Section

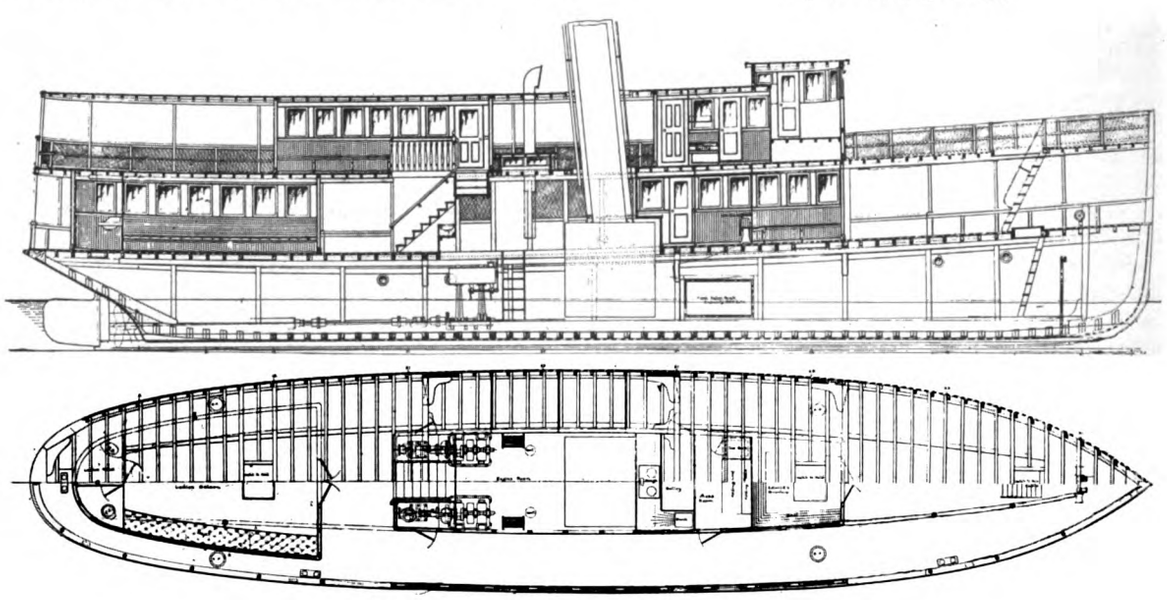

Fig. 2.—Construction Plans of the *Dixie*

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accommodation of passengers. A deck house, 20 feet by 10 feet, provides shelter in stormy weather, and also houses in the companion stairs to the lower deck.

As the requirements of the traffic for which the boat is designed demand a speed of twelve miles per hour loaded on a shallow draft, twin screws were adopted, driven by fore-and-aft compound direct-acting engines with cylinders 7½ inches and 16 inches diameter by 10 inches stroke. Steam is supplied by a watertube boiler arranged to burn wood, as wood is the only fuel that can be used economically in the region where the boat is to operate. There is a complete outfit of auxiliaries, including two feed pumps, a bilge pump, fire pump, engine room signals and a complete electric lighting plant.

According to the contract, the *Dixie* will be turned over to her owners not later than December 1, and she will then proceed to Florida to take up active operations in carrying fruit and passengers.

Stern-Wheel Motor Boat Tabasquena

Nowhere is the question of providing a maximum carrying capacity on a minimum draft of more importance than in the design of the freight and passenger boats used on the rivers of Mexico. Many of these streams, while they may have fair depth for most of their length, are full of sand bars which are constantly changing, and to provide against this a type of stern paddle wheel boat powered with either gasolene (petrol) or kerosene (paraffin) engines is being used with great success. This type is illustrated by the *Tabasquena,* recently designed and built by Percy Stout, Frontera, Tab. Mexico, and now in successful operation on a freight and passenger run of several hundred miles.

The *Tabasquena* is 60 feet in length overall and 50 feet at the waterline. Her beam is 12 feet 7 inches overall

The *Tabasquena*

and the molded beam 12 feet. Her shoal draft is 2 feet 9 inches, while her running draft is only 22 inches forward and 18 inches aft. The block coefficient at the working draft is .66 and the displacement approximately 20½ tons.

The power plant consists of a six-cylinder 60-70 horsepower "Buffalo" heavy duty engine, built by the Buffalo Gasolene Motor Company, Buffalo, N. Y., equipped with high tension ignition and an air starter. The transmission is by bevel gears running in an oil-tight case and chain and sprockets, the ratio of reduction being 13.3 to 1.

The paddle wheel is a ten-armed wheel split, making 30 buckets 11 inches by 44 inches pitched 18 inches. The diameter outside of the wheel is 8 feet 6 inches and operates at a normal speed of 35 revolutions per minute, the dip on running draft being 14 inches.

The fuel is carried in two tanks below decks in a sealed compartment. These tanks have a capacity of 400 gallons, which gives the engine fuel for 50 hours' continuous running at full speed.

The boat has a normal speed of about 12 miles per hour. On her trial trip of 21 miles she towed a 93-foot by 33-foot barge and two 90-foot by 20-foot barges, and easily handled the tow against a 3½-mile current, making the trip in five hours flat. When the engine is turning 375 revolutions per minute there is a fuel consumption of 7 gallons per hour, and at full speed, or 500 revolutions per minute, the fuel consumption is 7.6 gallons.

Producer Gas Freight Boat

The freight boat *Smyrna*, which is 65 feet long and 19 feet beam, runs between Smyrna, Del., and Philadelphia, Pa., and other neighboring ports. It has a capacity of 75 tons of freight and is equipped with a 65-horsepower

Freight Boat *Smyrna*

Wolverine engine and a suction gas producer plant manufactured by A. L. Galusha & Company, Boston, Mass. With this equipment the boat is enabled to carry a 75-ton cargo 62 miles on a consumption of one dollar's worth of fuel. The boat's regular run from Smyrna to Philadelphia is 62 miles, and the trip is made on an average of 6½ hours with a coal consumption of 432 pounds, which is less than one pound per horsepower hour. The coal used costs from $4 to $5 (16/8 to 1/0/10) per ton, which, with this plant, is as cheap as gasolene (petrol) or other oil fuel at 2 cents (0/1) a gallon. As compared with competing boats, the fuel bill of the *Smyrna* is only one-tenth of that of her competitors.

Oil Engines for Chinese River Boats

Two semi-Diesel oil engines have been supplied by R. Wilson & Sons, South Shields, for two Chinese vessels, to be used for general cargo and passenger service on the river at Hong Kong. The engines are of 72 and 84 brake horsepower, while two other engines of 180 and 105 brake horsepower are ready for shipment by the same firm. The larger engines have four and three cylinders, respectively, and are directly reversible by compressed air. While these engines are of the semi-Diesel type, there are no hot bulbs or water drips.

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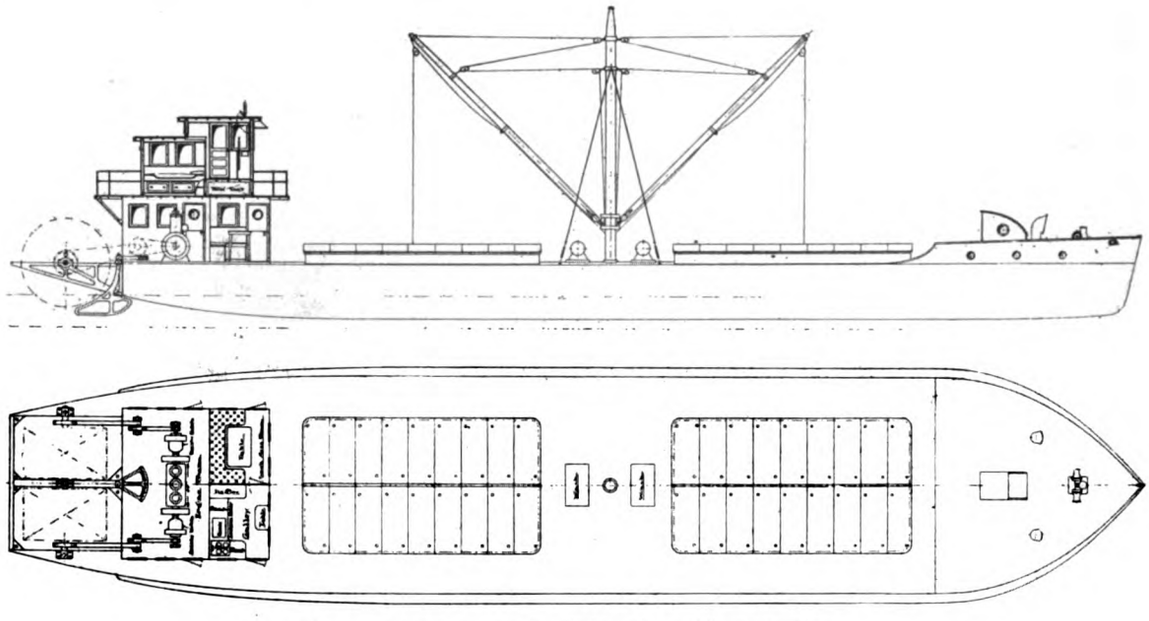
Motor-Driven Stern-Wheel Boat

The accompanying plans show a boat recently designed by J. Murray Watts, of Philadelphia, Pa., which will be one of a fleet to be operated between Galveston and Corpus Christi, Texas. These boats are built of mild steel of 10.2 pounds plating and are absolutely fireproof, the only wood used being in the pilot house. The dimensions are 110 feet by 24 feet by 6 feet. The cargo is carried in the hold and is loaded and unloaded by means of two power winches and two derricks through two large hatches. On a draft of 45 inches 150 tons can be carried and 200 tons if the depth of navigable water allows for further immersion.

The general appearance of the boat is similar to that used in most South American and gulf waters. The crew is quartered forward in an airy, raised-deck forecastle with very comfortable accommodations. There is a deck house built aft, and on top of this deck house are the captain's stateroom, toilet room and the pilot house. The main deck house contains the engine room, the crew's mess room and the galley.



General Arrangement of 110-Foot Stern-Wheel Freighter

The greatest interest centers on the adaptation of the stern wheel to the propulsion of these power boats. As the stern-wheeler is notoriously hard to handle in narrow channels, the following arrangement has been adopted as the best after a long experience with this class of boat: The main engine, a 100 horsepower motor burning cheap oil, is set up on heavy foundations athwartships, on the main deck, where it is as accessible as a stationary engine, and, like a stationary engine, it has a flywheel at each end of the crank case and a friction clutch connected to each flywheel. Through these friction clutches it drives a counter shaft with a Morse silent chain, giving a gear reduction of six to one. From this counter shaft runs a link belt chain to each paddle wheel (of which there are two). This double six to one gear, giving a total of twelve to one reduction, allows the main engine to run at 360 revolutions per minute and drives the paddle wheels at 30 revolutions per minute. The two paddle wheels are separated and so arranged that, when making a sharp turn, the inner paddle wheel can be declutched from the engine and drag, while the whole power of the engine speeds up to the outer paddle wheel, and so gives a very strong turning moment to the boat. These paddle wheels are of the feathering type, so that, in spite of the comparatively small diameter of 9 feet, they will have the efficiency of a very much larger diameter wheel on account of the buckets entering and leaving the water in practically a vertical line.

New United States Battleships California, Mississippi and Idaho

On October 6 bids were opened at the Navy Department, Washington, for the construction of three new battleships provided for by recent acts of Congress. As has been the policy of the Navy Department in previous years, bids could be submitted either wholly on the Department's plans and specifications, or on plans and specifications prepared by the contractor for the machinery, but on the Department's plans of hull and equipment. Four shipbuilding establishments submitted bids for the construction of the vessels, the lowest bidders being the New York Shipbuilding Company, of Camden, N. J., and the Newport News Shipbuilding & Dry Dock Company, of Newport News, Va. Each of these concerns offered to build one vessel within a specified time of thirty-six months.

As under the law one vessel must be built at a Government navy yard, the New York Navy Yard submitted an estimate to build one vessel for the sum of $7,155,300 (£1,457,000) on the Department's design for both hull and machinery, and another estimate of $6,992,859 (£1,433,000) for a vessel equipped with machinery for electric propulsion, the machinery of the latter type consisting essentially of turbine-driven generators furnishing electric current to motors driving the propeller shafts. The propositions of each of the other two bidders were substantially as follows:

1. The Newport News Shipbuilding & Dry Dock Company for one vessel to cost $7,115,000 (£1,456,000) on the Department's plans for hull and equipment, the engine installation to be turbines of the Curtis type. This installation has four shafts with separate high-pressure

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ahead and astern turbines placed on the outboard shafts and a combined ahead and astern turbine on each of the inboard shafts. To the inboard shafts are also connected an arrangement of separate high- and low-pressure cruising turbines operating said shafts by means of reduction gear. The turbines are substantially the same as those used on the battleship *Pennsylvania,* now building by this company, but the arrangement differs in that the cruising turbines connecting with the main low-pressure turbine shaft are placed outboard in the latter.

2. The New York Shipbuilding Company for one vessel to cost $7,175,000 (£1,470,000) on the Department's plans for both hull, equipment and machinery. The engine installation of this ship has also four shafts, but the turbines are of the Parsons type. Independent ahead and astern turbines are placed on the outboard shafts and combined ahead and astern turbines on the inboard shafts. The cruising turbine outfit in this case consists of only one turbine connecting, by means of reduction gear, to each of the inboard shafts.

The boiler installation of both ships is made up of 12 boiler units placed in three separate boiler compartments, all of the boiler uptakes leading to one smokestack. All boilers are equipped for burning oil fuel, no provision being made for coal firing.

The general features of the ships are as follows: Displacement, 32,000 tons; speed, 21 knots; total shaft horsepower, 32,000; main battery, twelve 14-inch B. L. R. guns.

Greater Safety and Efficiency in Paneling and Ceiling Passenger Vessels

Referring to the deck paneling, stateroom bulkheading, wainscoting, door panels, etc., of the modern excursion and passenger steamer, a prominent builder of passenger vessels made the following remarks in the discussion of a paper read at the twentieth general meeting of the Society of Naval Architects and Marine Engineers:

"We know that the substitution of composite board and of the so-called 'Nevasplit' panels is far safer than the pine panels formerly used, which were much heavier and would ignite more quickly, and their adoption has been quite a great advancement in the line of safety."

This expresses, we believe, the general opinion of naval architects and shipbuilders of the United States, as well as of many prominent men on the other side who are to-day paying more attention to this particular feature of construction than ever before.

There are many good reasons why this should be so, for with paneling material of this sort there is no possibility of checking or splitting, a feature which alone makes for sanitary construction. It is claimed that there is practically no expansion or contraction to the material, while thickness for thickness its weight is about the same as white pine, but where a 1-inch panel of white pine should be used, a ⅜-inch panel of the above type is sufficient for all purposes of strength or general durability. This feature shows a great saving in weight and some economy of space.

As against the necessity of studding staterooms and bulkheads generally, paneling of this type is mostly made up into rabbeted or grooved forms of 1¼-inch material in the joiner shop, and the completed sections are brought aboard the ship ready to slide into the moldings or grooves made to receive them. This feature shows another very marked economy of space, time and weight, and a very important saving in hand labor, as the principal labor is covered by machine work in the shop.

This material has been responsible for a marked change in design of the paneling of wainscots, walls, decks and doors, in that ⅜-inch panels are commonly used as free floating panels, which are merely slipped into rabbeted or grooved forms, many of which are 4½ feet wide, or even wider, and running the full height of the bulkhead or wall. Doors are made by rabbeting or grooving a single panel into the stile, without the danger of shrinkage or rattling panels, which would have to be considered had we dared to employ such a large panel of wood for door panels on shipboard.

Another feature of this manufactured product is, that while it is not impervious to water, or the long-continued action of moisture, it is, when painted, entirely unaffected by moisture and continues to harden and become more resistant with age.

Naval architects, ship builders and owners have shown a real progressive spirit in meeting the manufacturers of products of this sort fairly, and giving them every opportunity to prove their claims in a desire that the shipping fraternity might obtain a suitable material preferable to the typical pine sheathing or wood veneer construction for this class of work, with the result that during the past few years many of the finest inland and coastwise steamers built in the United States have included material of this sort throughout, wherever practicable. Several of these vessels have been described at length in recent issues of this magazine, including the Hudson River Day Line steamer *Washington Irving,* illustrated and described in the July, 1913, issue; the Hudson River steamer *Berkshire,* of the Hudson Navigation Company (July, 1913), and the passenger and freight steamship *Congress,* of the Pacific Coast Company, also described in the July, 1913, issue.

NON-INFLAMMABLE PANELS AND BULKHEADS

For several years manufacturers have persistently tried to produce a non-inflammable panel which would embody all the strength, hardness and water resistance of the regular material above described, and within the past year or two this has been accomplished to a certainty. One of the first ship builders of note to test carefully and take advantage of this material, was the firm of James Rees & Sons, Pittsburg, which built a light draft, all- steel boat* for Jones & Laughlin, of Pittsburgh, to run on the Ohio River. This boat has an all-steel hull and superstructure, excepting the non-inflammable "Nevasplit" door and bulkhead panels which went into cabin, saloon, passageways and staterooms.

Shortly afterward experiments were conducted by the Test Department of the Pennsylvania Railroad at Altoona, with a result that the reconstructed ferryboat *Pittsburgh* † was entirely sheathed with Nevasplit on the walls and decks of the vehicle gangways, which now constitute the entire main deck of this boat, some 20,000 feet of surface area. This material was adopted here for two reasons, namely, the impossibility of corrosion occurring on the back of the sheathing where it could not be painted after installation, and for its insulation value, retarding the transmission of the heat to the stanchions or carlines behind the sheathing, and in case of a sudden conflagration, which might be caused by an automobile or load of

* The *Aliquippa,* illustrated in this number.

† See October, 1914, issue of INTERNATIONAL MARINE ENGINEERING, page 433.

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hay taking fire, would prevent the fire from burning the walls or ceiling and spreading to the passenger deck and pilot houses above.

It is not, we think, too much to prophesy that in view of the large quantity of the regular material described at length in the earlier paragraphs, ship builders and naval architects generally will pay very much more attention in the future to this question of non-inflammable paneling, which in the total outlay of the ship means a comparatively trifling increased cost over the regular material, say a matter of $1,000 (£205) or $2,000 (£410) in the total cost of the boat. Surely the fact that a fire of considerable seriousness would undoubtedly be confined to the stateroom or compartment in which it originated, for a very considerable time before spreading to other rooms, should, and does, warrant serious consideration of such a product.

Shallow Water Navigation in Distant Lands

BY A GLOBE TROTTER

Novel craft for shallow water navigation are to be found in many parts of the world, and particularly in tropical countries, where transportation on land is difficult on account of the forest jungles. Some interesting types of such craft are shown in the accompanying illustrations.

Fig. 1 is a view of the river boats at Barranquilla, the most important port of the Republic of Colombia, South America. Barranquilla is located on the left bank of the Magdalena River about seven miles from its mouth. Because of the dangerous bar at the mouth of the river, navigation is carried on by light draft steamboats, many of which are built in the United States and shipped in knock-down form for erection at Barranquilla. These boats are able to ascend the river as far as Yeguas, where goods are transshipped by rail to Honda and thence by pack animals to Begota or by still smaller boats further up the river. Curious covered barges, such as can be seen at the left in the foreground of the photograph, are used for passage over the bar at the mouth of the river.

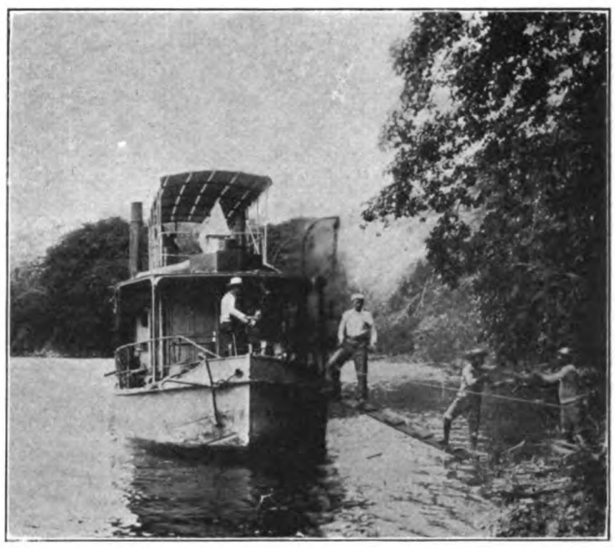

Fig. 2.—Steamboat on Lake Valencia, Venezuela

In Fig. 2 is shown a small steamboat in use on Lake Valencia, Venezuela, South America. Although a small boat, the vessel can boast of an observation deck on top of the cabin. The photograph shows the boat landing at the island of El Burro (The Mule).

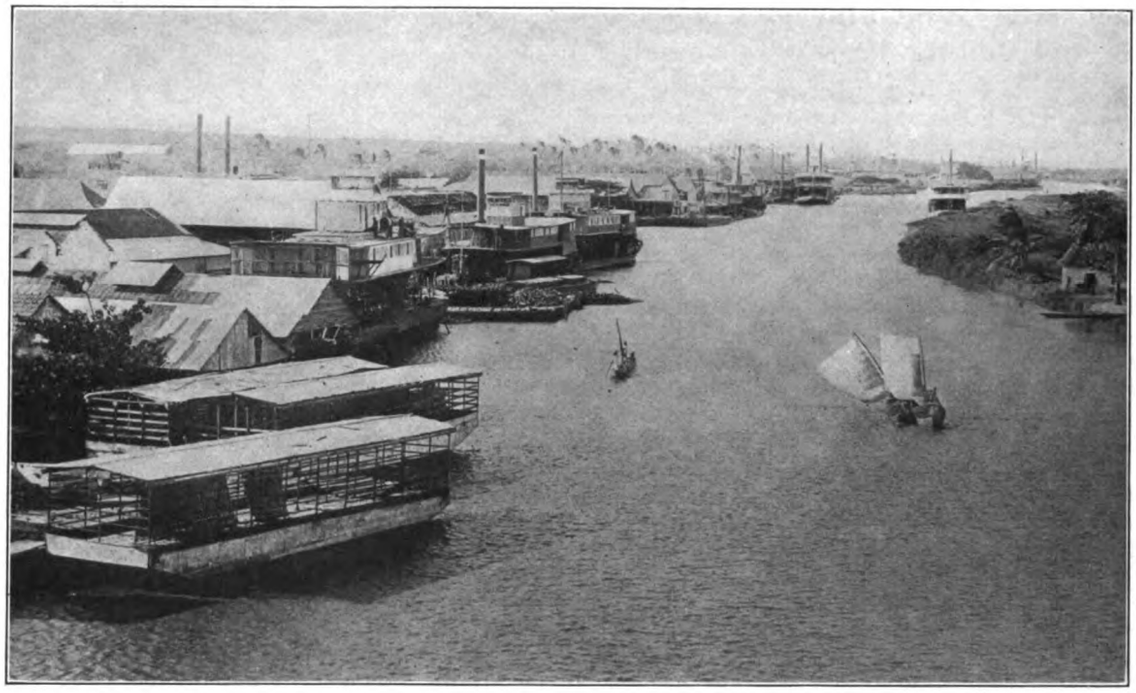

Fig. 1.—River Boats on the Magdalena River at Barranquilla, South America

In the harbor of Singapore, shown in Figs. 3 and 4, which is the most important port of the British Malaya, there are literally hundreds of small, curious, flat-bottom boats to be seen at all times. On account of the jungles and wilderness of the country, the Malays are averse to land transportation, and, consequently, make extensive use of these boats on the Singapore River. The boats are propelled by sail or by poling; the white covers over the boats are made of straw and are used to protect passen-

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Fig. 3.—Flat-Bottomed Scows at the Mouth of the Singapore River

Fig. 5.—Canal Boats at Batavia, Java

Fig. 4.—Singapore Harbor, the Most Important Port of the British Malaya

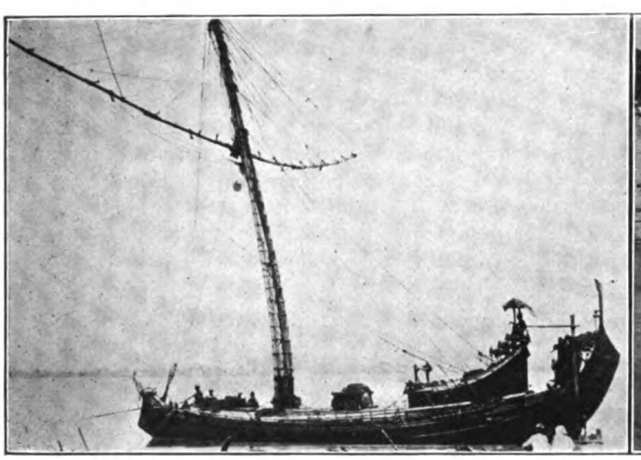

Fig. 6.—Burmese Paddy Boat on the Irawaddy River

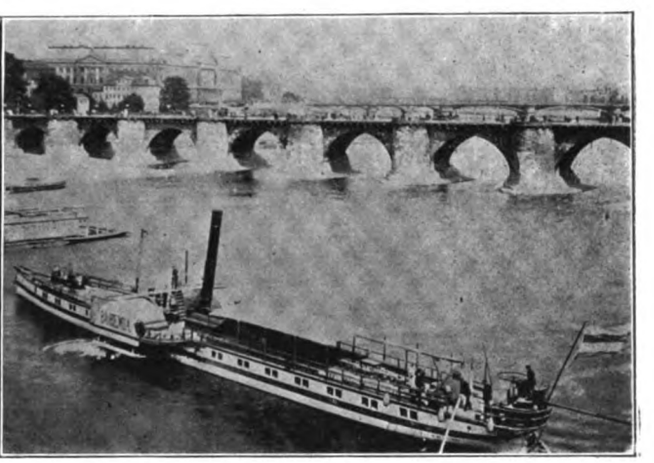

Fig. 7.—Side-Wheel Passenger Steamer on the Elbe River at Dresden, Germany

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gers or cargo from the fierce heat of the tropical sun or the drenching downpour of the frequent torrential rain storms. At the mouth of the Singapore River larger flat-bottom scows are used, such as are shown in Fig. 4.

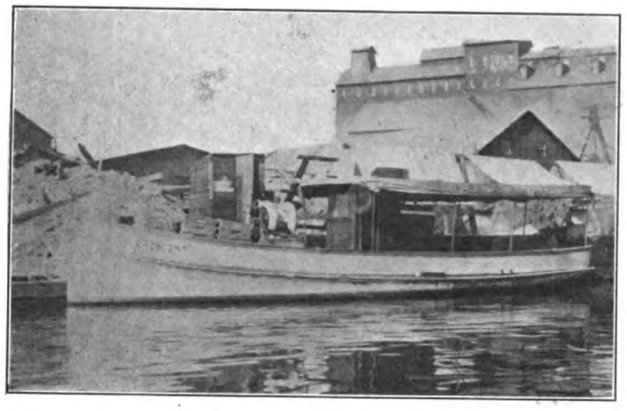
There are many canals in Java, and on all of these are found huge flat-bottom canal boats such as shown in Fig. 5. These boats are substantially built, and carry comparatively large cargoes. They are propelled by poling, or sometimes they are towed along from the bank. Fig. 5 shows a section of one of the canals in the city of Batavia, Java.

A different type of shallow draft boat is shown in Fig. 6. This is a typical Burmese paddy boat of the type that constantly plies up and down the Irawaddy River. An unusual feature of this boat is the crescent-shape spar, which is very slender and of the same length as the mast. The mast itself is double and consists of two spars lashed together. When under full sail before the wind, this boat has two large square mainsails, one on each side of the mast, and two small square topsails. Each paddy boat has a high poop deck, on which is a covered chair for the steersman, who steers the boat by means of a long tiller.

A more modern type of boat, which is capable of navigating extremely shallow waters, is shown in Fig. 7. It is a side-wheel steamer used for passenger traffic on the Elbe River at Dresden, Germany. So shallow is the river, and so short the turns, that a long pole is used at both the bow and stern to assist in turning the vessel. A man poling in the stern of the boat can plainly be seen in the photograph.

A Fisherman's Motor Boat

A 40-foot power boat, capable of a speed of seven miles per hour, is being used by Mr. Joseph Rapp, a fisherman of Erie, Pa., for daily runs averaging twenty-three miles

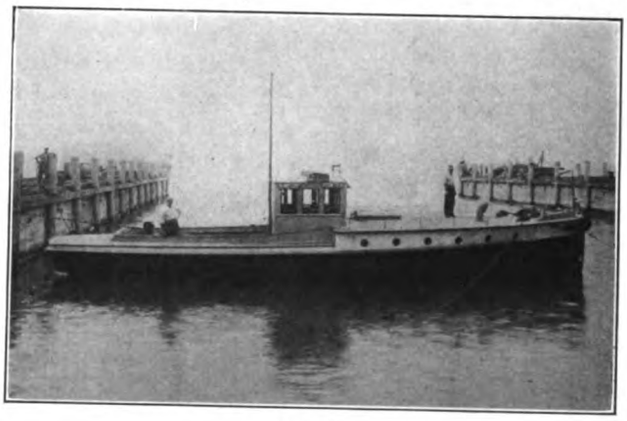


Fishing Boat *Crescent*

each day in the week. The boat is equipped with a 15 to 18 horsepower Fulton self-sparking engine, built by the Fulton Manufacturing Company, Erie, Pa., which turns a three-blade, 26-inch reversible propeller. The engine requires no batteries or coil.

Diesel-Engined Work Boat, Pointer of Baltimore

The Maryland Steel Company, Sparrows Point, Md., has recently placed in service for carrying freight and workmen in Baltimore harbor a 54-foot motor boat which is unique in that it is the first American boat to be fitted with a Diesel engine of American make and design of such small size as 50 horsepower. The motor is a three-cylinder engine with an 8-inch bore and 9-inch stroke rated at 50 horsepower when turning 400 revolutions per minute. The engine was designed and built by the Fulton Manufacturing Company, Erie, Pa., and on July 24 was given a thorough test in Baltimore harbor. The boat was run for a distance of 8.8 miles at a speed of 8.99 knots,



The *Pointer*

the engine running at 388.4 revolutions per minute. Although the builders guaranteed a consumption of only .55 pound of fuel oil per horsepower hour, the actual consumption was .4576 pound, or less than one-half pint of fuel oil. With oil at 3 cents (0/1½) a gallon, the fuel cost per hour was only 9⅜ cents (0/4 3/16). The dimensions of the boat are: Length, 54 feet; beam, 12 feet 4 inches; depth, 6 feet 2 inches; draft, forward, 2 feet 9 inches; aft, 4 feet 2 inches; displacement, 40,500 pounds. The propeller is 38 inches diameter and 38-inch pitch, with a developed area of 456 square inches.

Mietz & Weiss Oil Engine Installations on Commercial Boats

In many types of commercial boats Mietz & Weiss marine oil engines, operating on common kerosene (paraffin), fuel oil or crude oil of suitable quality, are installed with very satisfactory results. No gasolene (petrol) is used in engines of this type, and they are, furthermore, free from such complications as electric ignition devices, carbureters, vaporizers, cams, gears, valves, cam shafts and the like, which, added to the low operating cost, safety, simplicity and reliability of operation, make the engine a most desirable class of power for a work boat proposition. These engines are furnished by August Mietz, 128 Mott street, New York, in three-cylinder units and over. They require no reversing clutch, the engines themselves being started and reversed in the same manner as an ordinary steam engine, using, however, compressed air from an air storage tank, which in turn is supplied by a small air compressor attached to and operated by the engine. For large units a separate air compressor unit is furnished so that the air can be compressed independently of the engine.

A feature of the Mietz & Weiss engine is the S. & W. distributor, which is a rotary valve with positive drive from the main shaft of the engine, controlling the flow of air from the air pressure tanks to the cylinders in proper order for rotation in either direction at the will of the operator at the controlling lever in front of the engine. A feature of primary importance in the reversing of oil fuel engines is the control of the oil injections; that

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is, the oil injections must cease positively as soon as the controlling lever is moved to reverse the engine, allowing compressed air to enter the cylinders in counteraction to its normal rotation. It is claimed that the S. & W. distributors solve this problem by a very simple mechanism of positive movements. The controlling lever moves over a dial which is lettered "ahead," "astern" and "stop." The compressed air is shut off on the "stop" mark or flows to the engine for a direction of rotation, according to the dial indication. The movement of the lever also positively controls the oil to the engine, or to a by-pass, in such a manner that the oil is cut out first. The engine can then receive no oil unless it again starts to run in whatever direction desired, and to the position of the controlling lever. In the "stop" position of the lever, the air pressure is shut off and the oil cut-out is positively locked.

Some typical installations of the Mietz & Weiss oil engines on work boats are shown in the following illustrations. Fig. 1 shows one of the harbor police boats, two of which are in operation in New York harbor equipped with Mietz & Weiss 15 horsepower double cylinder engines. Fig. 2 is a view of the ferry *Miss Vandenberg*, owned by the Ogdensburg & Prescott Transportation Company, Ogdensburg, N. Y., and plying between Ogdensburg and Prescott, Ontario. This ferry is equipped with two 75-horsepower Mietz & Weiss three-cylinder units and has been in operation since 1910. Fig. 3 is a stern-wheeler used by the Canadian Government for survey purposes in the Saskatchewan district. This boat is equipped with a Mietz & Weiss 15-horsepower double cylinder oil engine. Two 50-horsepower Mietz & Weiss double-cylinder oil engines are installed in the tugboat *Robert* shown in Fig. 4, used by the Atlantic Freight & Steamship Company in tropical regions for towing fruit scows. At the present time the Mietz firm is building for the Lighthouse Service of the United States Government a 100-horsepower Mietz & Weiss direct reversible engine for lightship No. 98 for use on the Great Lakes, and also a 150-horsepower three-cylinder reversible engine for lightship No. 54, for use on the New England coast.

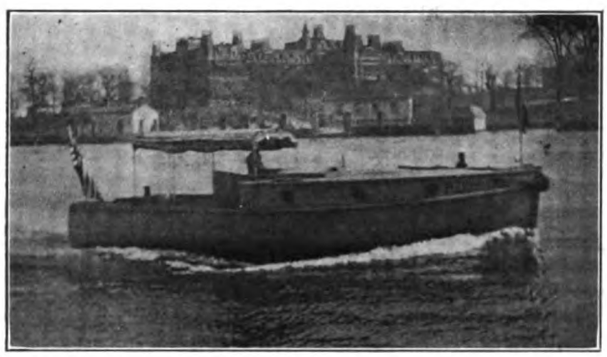

Fig. 1.—Harbor Police Boat

Fig. 2.—Motor Ferry Boat

Car Ferry Henry M. Flagler

A new car ferry for the Florida East Coast Railway System is now nearing completion at the yards of the William Cramp & Sons' Ship & Engine Building Company, Philadelphia, Pa. The vessel was designed by M. C. Furstenau, naval architect, Philadelphia, and will transfer cars between Key West, Fla., and Havana, Cuba, a distance of about 100 miles. The hull is 360 feet long over all, 57 feet beam molded, 22 feet depth molded, with a deadweight carrying capacity of 2,500 tons at a draft of 15 feet. Four sets of tracks are arranged on the main deck, giving accommodations for thirty of the largest size refrigerator cars. The designed speed of the vessel loaded is 13 knots, and it is expected that the run of 100 miles from dock to dock will be made in eight hours.

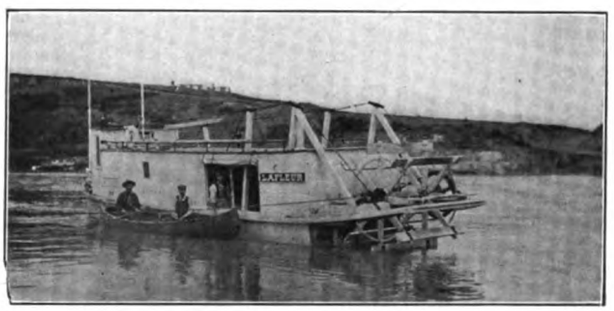

Fig. 3.—Canadian Government Survey Boat

Fig. 4.—Tugboat *Robert*

The power plant consists of two triple expansion engines having cylinders 20 inches, 32½ inches and 54 inches diameter by 36 inches stroke. Each engine is designed to develop 1,500 indicated horsepower. Steam is supplied by four Scotch boilers, each 13 feet 2 inches diameter and 12 feet long, fitted with two 48-inch Morison corrugated furnaces and designed to operate under the Howden system of forced draft at a working steam pressure of 170 pounds per square inch. Coal will be used for fuel.

The usual auxiliaries are fitted in the engine room, the only notable difference being the fitting of two 12-inch centrifugal pumps by which the ballast tanks can be filled or emptied in a short space of time. The ballast tanks

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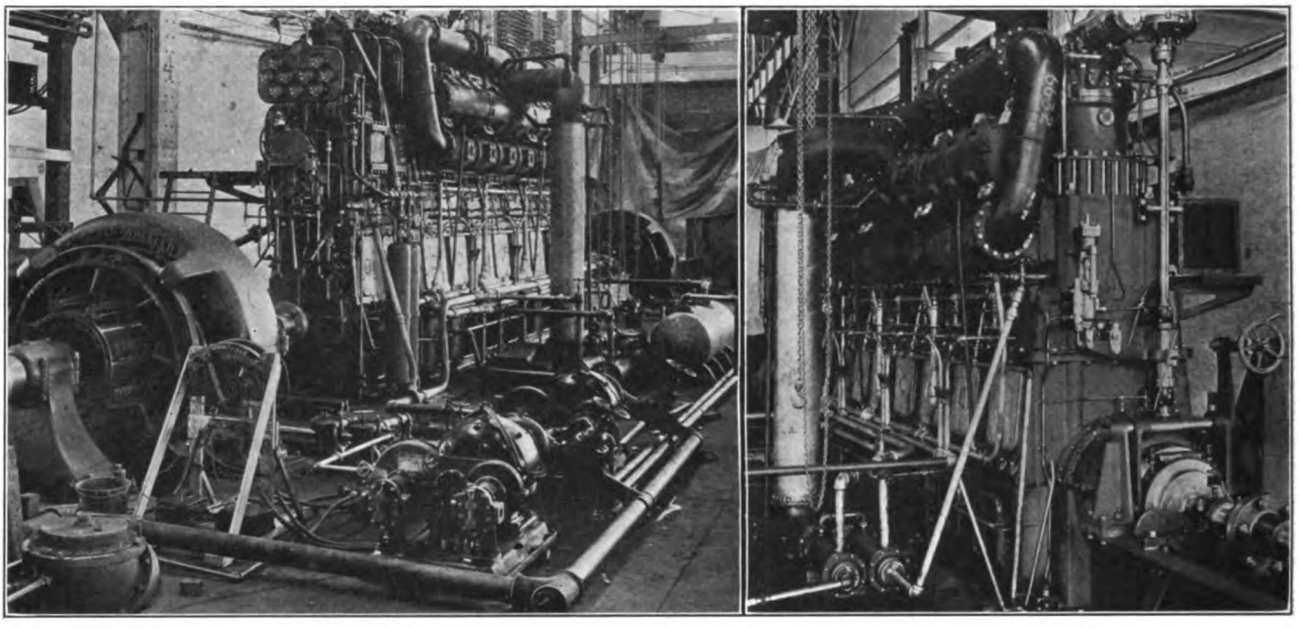
have a sufficient capacity to load the vessel to her normal draft in case no cargo is carried.

In addition to the arrangement for carrying cars, the vessel is fitted with three cargo holds having a capacity for storing approximately 300 tons of cargo. Each hold is served by a double drum electric cargo hoist. In addition to the dry cargo, one of the forward ballast tanks has been arranged for carrying molasses, the necessary filling and discharging apparatus being fitted.

The keel of the vessel was laid at the Cramp shipyard April 20, 1914, and all of the machinery was completed and the vessel launched on September 22. It is expected that the vessel will be placed in commission during the early part of December. Both the hull and machinery have been built to the highest classification of Bureau Veritas under the supervision of the designer of the vessel.



Two Views of 1,000 Horsepower Nlseco Marine Diesel Engine Undergoing Shop Test

Shop Test of 1,000 Horsepower Marine Diesel Engine

There has recently been completed at the works of the New London Ship & Engine Company, at Groton, Conn., a 1,000-horsepower marine Diesel motor of the Nlseco type. This engine, which is the largest marine engine of its kind constructed in the United States, has recently completed its shop trials, and we are able to give some of the results obtained.

The engine was placed on the test stand and connected through shafting to two 600-kilowatt generators, one of which was placed at the forward end and one at the after end of the engine. Two generators were used, as there was no single generator available of sufficient size to supply the necessary load. The current from the generators was absorbed by water-cooled rheostats.

The pumps for circulating water, lubricating oil and piston cooling water were assembled on a common bedplate and driven by electric motors. These pump sets were in duplicate, but only one set was used for the engine at full power, the other being an auxiliary set used as a standby in case of breakdown of the first. The arrangement of pumps was not identical with the arrangement on shipboard, but the pipe connections and arrangements of piping were laid out to duplicate as nearly as possible the conditions which will obtain when the engine is installed. The current for driving the motors was taken from the generators driven by the engine.

The fuel oil supply tank was placed at a high level in order to feed to the fuel pumps by gravity, this being the arrangement on shipboard where a gravity tank is installed.

The current from the generators was carried through ammeters and voltmeters upon a switchboard before passing through the rheostats, in order that readings might be taken to determine the horsepower generated. Thermometers were installed at different points on the engine to determine the temperature of the circulating water at the inlet and outlet, the temperature of the scavenger receiver and the temperature of the lubricating oil at the inlet and outlet.

A number of different test runs were made, the longest being one of 48 hours, which was made at approximately 900 horsepower. Shorter runs were made at varying powers from 200 to 1,100 horsepower. Although the engine is rated at 1,000 horsepower, at 1,100 horsepower there was evidently considerable reserve power without excessive fuel consumption or without excessive smoke in the exhaust. The general results of the tests were very satisfactory, especially in consideration of the fact that this was the first engine of its size to be built in this country.

On the 48-hour test the following results were obtained:

Average brake horsepower	906.37
Average fuel consumption, pounds per hour	467.68
Average fuel consumption, pounds per horsepower-hour	.515
Total fuel consumed, pounds	22,448
Total fuel consumed, gallons	3,161.6
Total lubricating oil consumed, gallons	125
Total fresh water consumed, gallons	132

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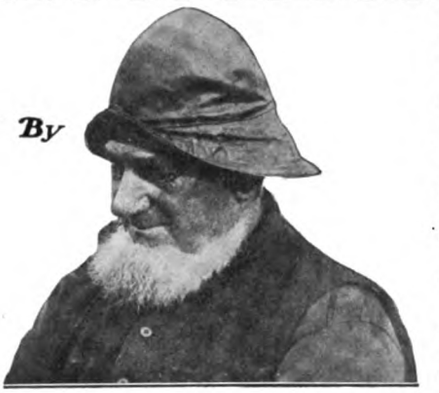
Economy Talks "Old Scotch"

By



The American Merchant Marine

Brother engineers, I'm going to take for my text to-day "The American Merchant Marine," as I do not know of any subject that is of more economic importance to this country just now than to have enough ships flying our flag to carry our products, and, incidentally, to give employment to all of us. I am one of the few living American engineers who can remember when we had "right smart" (as they say down South) ships of our own in the foreign trade. "Right smart" applies to quality as well as to numbers, as we certainly had some corking good ships that could outsail anything afloat. But, alas and alack! that noble old fleet has gradually disappeared from the ocean. I'm not so much interested just now as to how they disappeared as I am in how to get another fleet.

We really need our own ships in the foreign trade more now than we did when we had one of the best fleets in the world. That may sound strange, but fifty or sixty years ago, when we had ships, we were practically a nation of farmers, and exported, principally, the products of the soil, which foreign buyers were bound to have, anyhow, as they needed our stuff to live on; nowadays we still export some foodstuffs and raw materials, but are gradually getting to depend on manufactured articles for our export trade, and that's how we are going up against some pretty hard competition, as other nations are "some pumpkins" at manufacturing the same stuff that we do. In fact, all the great nations of the earth might be compared to rival business houses trying to sell their goods to the other nations which are not so great, and to each other, of course. I'm sorry to say that just now several of our larger friends in Europe have suspended business and gone to fighting for a living.

Anyhow, in this battle for trade it looks as if we ought to conduct ourselves like a good business house, and as any first-class business establishment has to have its own delivery wagons, if it wants to stay in business long, it looks to me as if this good old U. S. A. of ours was rather overlooking its hand by trying to deliver about all of its goods in the other fellows' ships, which, after all is said and done, are nothing but the delivery wagons of the sea. Wouldn't you give the laugh to an oil drummer who tried to sell you enough lubricating oil for a voyage and said he would have to deliver it to you in one of his rival's wagons, as his firm didn't believe in hiring drivers and supporting horses?

Of course, there isn't a bit of doubt but what foreigners can run ships cheaper than we can, and that is due principally to the fact that we fellows who run the ships here get more pay and are better fed than the people on foreign ships. I don't hear any of you remarking that you would like to work for any less than you do now, or that you would put up with poorer grub. Now, as long as we have got to have our own ships for the foreign trade in order to get our share of the world's business, and none of us who run the ships is going to accept any less than he gets now, if he can help it, what's the answer?

I'll tell you what it is! The Government has got to help out. And why shouldn't it? Do you know that every dog-gone business of any kind in this country is protected except our merchant marine in the foreign trade? That isn't possible, you say. Well, just think it over and you will conclude that I'm right. Every industry is protected either by the tariff, the climate or the great oceans on both sides of us. The Atlantic and Pacific are more consistent protectors than the tariff, as they never vary. No matter what you manufacture in this country, you're bound to have from three to four thousand miles cost of freight in your favor before any foreign goods can be brought here to compete with you. Not so with our registered merchant marine, as that has to get out and hustle in open competition with the ships of all other nations; and worse than open competition, they have to go up against rivals who are subsidized by their governments, in the bargain. This subsidy business doesn't seem to appeal to our law makers, but you can bet it's the surest way to keep your ships going. I felt the same way about tips when I boarded in a restaurant. I just got my back up and allowed as how I would be gol-darned if I was going to resort to any such un-American, undemocratic and outlandish foreign practice as giving tips to waiters who were already drawing pay for their services. I kept my back up for about six months, and I was always the last one waited on; my potatoes were always cold; the only parts of the chicken I got were the neck and wings, and on Fridays I varied between the gills and the tail of the fish. I got so thin by that time that after a final cursing of the fiendish system I began digging up a tip every once in a while, like all the rest of the fellows at the table. You can see that I haven't been very thin since then.

The foreign shipping department of the U. S. A. has been living on necks, wings and gills for a long while. As a result of losing over two hundred and fifty millions of dollars every year to foreign delivery wagons your Uncle Sam is getting rather thin in his exchange department. If he wants to fatten up his finances a bit he'd better be giving out a tip now and then to encourage his own merchant marine. If he doesn't like to swallow the subsidy system outright, as all his rivals are doing, let him ease off his conscience and enroll all of us ship drivers in his Naval Reserve and give us enough pay out of his vaults to make up the difference between the pay rates on foreign vessels and the American standard of wages, which gives us a decent living. In this way ship owners could afford to put vessels in our foreign trade and our dear old Uncle, by going down in his jeans annually for only four or five million dollars, would keep at least half of that two hundred and fifty million delivery-wagon money at home.

Yours for economy,

Old Scotch

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Questions and Answers for Marine Engineers

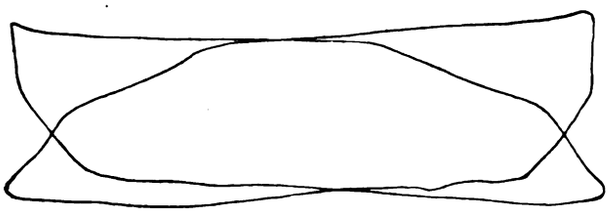
Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

CONDUCTED BY H. A. EVERETT*

This department is maintained for the service of marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so. Indicator cards taken from marine engines will be carefully analyzed, the defects pointed out, and the horsepower calculated, provided complete data are sent with the cards.

Q.—I have been running on one of the regular steamers between Boston and Savannah, and have had more or less trouble with the high-pressure engine. The inclosed card is taken from the high-pressure cylinder of the engine, which is a triple expansion engine, and I should be glad if you would explain what defects the card shows, the causes of same, and how they may be remedied? L. L.

A.—There is insufficient information as to what sort of trouble is encountered to permit of any definite answer. The card is not seriously defective in any particular and



Indicator Cards from High-Pressure Cylinder of Triple Expansion Engine

the only undesirable feature shown is the rise in the back-pressure line of the left-hand card (probably the bottom card, though the question gives no information) which indicates restricted exhaust. This might be due to too much exhaust lap, or improper valve setting. It is probable that the troubles experienced arise from improper mechanical adjustment or alinement.

Q.—Does it cause any weakening of iron pipe, or any article made of iron or steel, by having it galvanized? No. 30.

A.—If properly done, galvanizing does not cause any reduction in strength in articles commonly so treated. In very thin piping or sheets the acid treatment previous to the zinc bath may cause sufficient reduction in the original metal to affect the strength. If two articles, one galvanized and the other not, are to be compared for strength, care should be taken to use the dimension under the galvanizing for proper comparisons, as zinc has much less strength than steel.

Q.—Please inform me regarding the conditions which determine the sequence of cranks in a four-crank vertical marine engine. Also the approved method of ascertaining this sequence in an engine of the type mentioned by simple inspection; that is, without disconnecting any parts. W. S.

A.—The sequence of cranks has an appreciable effect upon the resultant rotative effect diagram of any multiple crank engine, and a proper balancing of the engine must take this into account. This comes from the fact that the order in which the different cylinders below the high pressure take steam from their respective receivers materially affects the character of the steam forces in these cylinders, and this is shown in the indicator diagrams. To determine what the sequence is in any engine stand aft of the engine and record each crank as it passes the upper dead point when turning over in the go-ahead direction.

Q.—I have always been under the impression that when the steam space was doubled the steam pressure was halved. Some ten years ago I was chief engineer of a twin-screw steamer of about 2,500 indicated horsepower. We had two double-ended steam boilers. We laid up our steamer for the winter months. When we were getting ready for the summer's work, I found the safety valves on the starboard boiler leaking badly, so I drew the fires out of both boilers, blew off the steam on the starboard boiler and overhauled the safety valves. After having the valves, as I thought, put to rights, in order to save further delay I opened up the stop valves of both boilers. At that time the port boiler had a pressure of 100 pounds, and I supposed that by connecting to the starboard boiler the steam pressure would drop to 50 pounds, but, instead of that, it dropped only to 90 pounds. I would like to have an explanation of this. P.

A.—The law stating that the volume is inversely proportional to the pressure holds only for a perfect gas and assumes a *constant quantity* of gas is dealt with (as one pound). The reason the pressure did not drop lower (assuming the boilers were filled to the same level) was that the boiler at 100 pounds immediately began to make steam when the pressure, and therefore the temperature of the steam in it, was reduced by letting the steam over into the other boiler. Then the water was still at about 338 deg. F. and the steam at a much lower temperature, so that water vaporized into steam and the pressure rose till equilibrium was restored. Of course, if the water level in the overhauled boiler was higher than that in the other, it would augment this rise. If you could have isolated the steam in the 100-pound boiler and let it expand into a space equal to twice the steam space of the boiler the resultant pressure would have been very nearly 50 pounds.

Q.—What is meant by corresponding speeds of experimental models and full sized vessels? Exp.

A.—If one imagines a small vessel to grow in size, all linear dimensions would expand in the same proportion, and the resultant large ship would be geometrically similar to the original. The speed would also grow, but in the proportion of the square root of a linear dimension. This comes from the fact that the resistance is assumed to be proportional to the displacement and the density of the water remains constant as follows: $R \propto D$. D = displacement; R = resistance; but displacement being a volume varies as the cube of a linear dimension so that $R \propto l^3$.

The resistance is a force and so is proportional to $\frac{mv^2}{l}$, where m and v are mass and velocity respectively, then

$$l^3 \propto \frac{mv^2}{l} = Il^3 \propto mv^2$$

and as the density of the water does not change

$m \propto l^3$, substituting we have $v \propto \sqrt{l}$.

So that if two similar ships have lengths of l and l', the speeds proportional to the square roots of their lengths are called corresponding speeds. If 25 feet and 400 feet were lengths, respectively of model and ship, the model being driven at 5 knots speed would correspond to a speed of 20 knots for the large ship.

$$\frac{5}{V \text{ of ship}} = \sqrt{\frac{25}{400}}, \text{ therefore } V \text{ of ship} = 5 \times 4 = 20 \text{ knots.}$$

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Q.—What is the relation between propeller thrust in a ship and towing force of a model at corresponding speeds? H. S.

A.—The relation between the resistance of a ship and the resistance of a model at speeds proportional to the square roots of the lengths is given approximately as proportional to the displacements. Strictly, this applies only to the wave-making resistance, as the frictional resistance does not follow the law of comparison, but for first approximation it is sometimes applied to the total resistance. To predict the resistance accurately it is necessary to separate the model resistance into its frictional and wave-making components, expand the wave-making as above, and figure the frictional for the large vessel, taking account of the reduced coefficient of friction for the larger ship and add together. This gives total resistance, which, however, is not exactly the propeller thrust, as that is slightly augmented by the wake.

Q.—Please give formulæ for horsepower required in estimates of thrust and speed for screw and paddle-wheel propulsion. H. F. B.

A.—A formula based upon the theory of mechanical similitude for the effective horsepower of ships is as follows:

$$E.\ H.\ P. = .000307\left(f\ S\ V^{1.83} + \frac{b\ D^{2/3}\ V^{3}}{L}\right)$$

where the individual letters have the following significance: f, coefficient of friction of water on the wetted surface; S, wetted surface of the ship; V, speed in knots; b, factor for wave-making resistance; D, displacement in tons, and L, length on the waterline.

For well-formed ships of moderate speeds the coefficients f and b may be given the values of .01 and .5, respectively. This gives the *effective horsepower*, which is the *net power* used to drive the vessel. This should be increased by the losses in the engine and propeller in order to get the indicated horsepower. If we assume an engine efficiency of .85 and a propeller efficiency of .65, the resultant efficiency of propulsion becomes .55 and the formula for indicated horsepower may then be written

$$I.\ H.\ P. = .0056\left(.01\ S\ V^{2.83} + \frac{.5\ D^{2/3}\ V^{3}}{L}\right)$$

If the efficiency for propulsion in case of the paddlewheel is different from the .65 assumed for the propeller, that will affect the formula in the same proportion. This formula is useful when data from other vessels similar to the one to be designed are lacking. If vessels similar to the one to be designed are available the admiralty coefficient formula should be used of I. H. P. $= \frac{D^{2/3}V^{3}}{K}$, K being derived from the prototype, for which data are available.

Q. Please explain how the gross tonnage of a ship is computed. T. A.

A.—There are three tonnages customarily referred to as registered tonnages—gross, net and underdeck. The one first derived is the *underdeck tonnage*, which is defined as volumetric contents of the entire vessel below the tonnage deck. The tonnage deck is the upper deck in ordinary full scantling vessels and the deck below the shelter or awning in shelter or awning deck vessels. This tonnage is simply the volumetric capacity of the entire interior of the vessel below the bottom of the beams of the tonnage deck, and taken to the inside of the sheathing and over the top of the double bottom. In practice it is determined by taking the areas of a number of transverse sections, in accordance with the rules of the Department of Commerce and Labor, and summing them by Simpson's rule for volume. To the underdeck tonnage should be added all spaces which come under the heading of permanently covered and closed in spaces on the upper deck. This gives the *gross tonnage*. *Net tonnage* (from an economic point of view the most important, as it is almost universally accepted as the legal basis for levying port charges, pilot dues, etc.,) is obtained from the gross tonnage by subtracting the spaces set apart for propelling power, crew spaces, master's accommodation, chart room, boatswain's stores, donkey engine space, etc.

Q.—Please explain the comparative merits and demerits of steam, electric and hydraulic cargo gears on board ship. What is the reason that electrical cargo gear is used to such a limited extent on American steamers? C. C.

A.—It is difficult to give a reasonable comparison of the merits and demerits of the different gears mentioned, as the installation of electrical, and, especially, hydraulic cargo-handling gears are few. In brief, the comparison may be listed as follows:

	Steam.	Electric.	Hydraulic.
First cost	Cheapest.	High.	High.
Speed of discharged cargo	Fast.	Fastest.	Slow. Most suitable for heavy work.
Maintenance lost	Slight.	Moderate.	May be high.
Local consumption	High.	Best.	High but better than steam.
Weight	Heavy.	Heavier.	Heaviest.
Noise and vibration	Great.	Less.	Least.

The repairs to the steam can usually be looked after by the regular engineer's force, and the system is usually operated from the donkey boiler in port. The electric may be operated from a shore plant. Hydraulic cannot be used where low temperatures are found, as it will freeze up.

Q.—As an estimate for a ship is often required in a hurry, will you kindly give some satisfactory method of obtaining the steel weight rapidly, say, for the hull, excluding superstructure and deck-houses of a ship, for which there is no basis to work from? Also what percent difference is there in this weight between Lloyd's, Bureau Veritas and British Corporation Rules? A. O. T.

A.—The difference in finished steel weights for the same ship built to Lloyd's, Bureau Veritas and British Corporation Rules is very low, much less than the accuracy of any formula which can be used for estimating hull steel weight. The methods of determining approximately the hull weights for estimating purposes may be divided into two classes; one, the cubic number method, and the other the surface foot method. In the cubic number method, so-called, the weight of hull is taken as the percentage of the product of the length, breadth and depth, the percentage varying with the type of the proposed ship. This method assumes that the hull weight is a function of the ship's volume, and while this is partially true, it is more nearly proportional to the superficial area of structural work than to the volume enclosed. The ratio of superficial area to volume is not constant, but is dependent upon the proportions of length, breadth and depth, so that there are considerable variations in the coefficient used in the cubic number method even for vessels of the same general type. This coefficient ranges from .36 to .43, and the formula should be used with considerable discretion. The larger coefficients are found with the vessels having the largest ratio of length to depth and breadth to depth. The surface foot method assumes that the ship's weight is a function of the area of the sides and bottom of a trough whose width is equal to the breadth of the hull and whose depth is the depth of the hull; thus:

$$\text{Surface foot} = L \times (B + 2d).$$

As the weight of structural work of a given hull is proportional to its gross surface, this method usually gives

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somewhat more accurate results than one depending upon enclosed volume, and for ships whose interior arrangement of bulkheads and decks is similar, gives reasonable satisfaction. The pounds per surface foot usually range from 97 to 125. From the above it is obvious that the steel hull weight of any new design cannot be determined with accuracy, unless the vessel is similar to some existing construction of which the weights are known, but these may serve as a help in getting out approximate estimates of weights for moderate-sized passenger and freight vessels.

Q.—I have a 12-inch by 18-inch double engine, cut-off .7 of the stroke, 85 pounds boiler pressure, non-condensing, 80 revolutions per minute. About what horsepower would it indicate? I intend to convert the above engine into a compound condensing engine; what size should the high-pressure and low-pressure cylinders be to indicate the same power? What percentage saving in coal consumption should I expect? What is the best method of propulsion for towing, the screw propeller or the paddle wheel? C. P.

A.—The single-cylinder engine will have about 90 indicated horsepower at 80 revolutions per minute. A compound condensing engine to develop this indicated horsepower may be 12½ inches by 28¼ inches by 15 inches stroke. Assuming cut-off in the high pressure at .6 stroke and cylinder ratio of $\frac{1}{2.5}$ and revolutions per minute = 80.

Business for the Big Schooners

The Coastwise Transportation Company, of Boston, Mass., which operates five steel 5,000-ton steamers and four large schooners in the Atlantic coast coal trade, recently inaugurated a new system for the prompt delivery of its commodity when the steamer *Middlesex* sailed from Norfolk with the four-mast schooner *Henry W. Cramp* in tow, both bound for Boston with cargoes. The expedient suggests more extensive adoption as a means of temporary employment for the many big schooners which have been lying idle in recent months; as for instance the four-, five- and six-masters of the Winslow Company, of Portland, Maine, seventeen of which were laid up several months last summer for want of charters.

It is pointed out that the big fore-and-afters could emulate the genus barge to the extent of going to sea with skeleton crews, astern of steam colliers or tugs; earn at least small dividends for their owners, and stand ready to re-enter business under their own sail at such time as a demand for both steam and sail tonnage reasserted itself, as it undoubtedly will after the present depression in the freight market.

This method of transportation has been successfully tried out in other trades. The ill-fated *Thomas W. Lawson*, the only seven-mast schooner ever built, had been fitted with tanks and towed in the oil trade under long-time charter from her owners, the Coastwise Transportation Company, though she was under her own sail when wrecked on the Scilly Isles, December 13, 1907, on a passage from Philadelphia to London.

The steel five-master *Kineo*, lately sold by Arthur Sewall, of Bath, to Baltimore owners, likewise was used as a tank barge in the Gulf oil trade, but at present is making regular voyages under canvas. The wooden five-master *Harwood Palmer*, now running between Hampton Roads and Portland in the coal trade, was chartered by the Union Sulphur Company a few years ago and brought several cargoes of the crude product from Texas to New England ports in tow.

Indeed, an argument against dismantling the big schooners and permanently converting them to barges is seen in a recent performance of the steel-tank, six-master *Delaware Sun*, owned by the Sun Oil Company, of Philadelphia, which, though shorn of her topmasts and officially rated as a barge, still retains much of the sail spread that she had when she was the collier *William L. Douglass* and owned by the Coastwise Transportation Company.

The *Delaware Sun* was bound from Philadelphia to London with a cargo of oil in tow of the tank steamer *Yosemite* when she broke adrift in a heavy gale in mid-ocean. The steamer, harder hit than her consort, sought shelter without trying to pick her up again. The *Delaware Sun* accordingly made sail and went into the Thames on her own hook. Meanwhile the *Yosemite*, an ancient craft, had been towed to the Tyne and condemned. So the *Delaware Sun*, left to her own resources again, discharged her cargo and sailed back to Sabine Pass, Texas, although under her short sail it took her fifty-seven days to make the passage.

On the Lakes the many large schooners which were unlucky enough to be serviceable when steam craft usurped the last vestige of their business were permanently dismantled at a sacrifice, and without exception are ending their days as barges. But on the Pacific coast the Union Oil Company, of Los Angeles, and the Associated Transportation Company, of San Francisco, are going both the Atlantic and the Great Lakes one better.

Their fleets of tankers include the four-mast steel ship *Erskine M. Phelps*, late of Bath, and the Glasgow-built ships, *Falls of Clyde* and *Marion Chilcott*. These staunch craft are permitted to keep their yards aloft as in their palmy, wind-jamming days, and make voyages either under sail or in tow as the exigencies of the trade require.

LLOYD'S QUARTERLY SHIPBUILDING RETURNS FOR THE UNITED KINGDOM.—At the close of the quarter ended September 30, Lloyd's Register of Shipping reports 486 merchant vessels of 1,723,550 gross tons under construction in the United Kingdom. Although the tonnage now under construction is about 1,400 tons more than that which was in hand at the end of the last quarter, the rate of progress in merchant ship construction is much reduced on account of the war, and the immediate output will be correspondingly less than would be attained under normal conditions. The war also makes it impossible for Lloyd's to publish for the present the usual information regarding the shipbuilding industry throughout the world.

SHIPBUILDING RETURNS IN THE UNITED STATES.—According to reports from the Bureau of Navigation 283 vessels of 56,510 gross tons were built in the United States and officially numbered during the three months ended September 30. As compared with the tonnage built in the corresponding quarter last year, this shows a decrease of 37 percent. During the month of September 83 vessels of 17,184 gross tons were built and officially numbered, the largest being the *Medina*, of 5,426 gross tons, built by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., for the Mallory Steamship Company, New York.

LAUNCH OF LARGE WESTERN RIVER EXCURSION STEAMER.—On October 17, the hull of a large steel river excursion steamer was launched at the yards of James Rees & Sons Company, Pittsburg, Pa. The boat is 160 feet long, 40 feet beam, with 3-foot guards, making a total width of 46 feet. The depth of the hold is 4½ feet. The vessel is built of steel throughout, and is divided into forty-one watertight compartments. She will be used in southern waters, principally in the vicinity of Memphis, Tenn.

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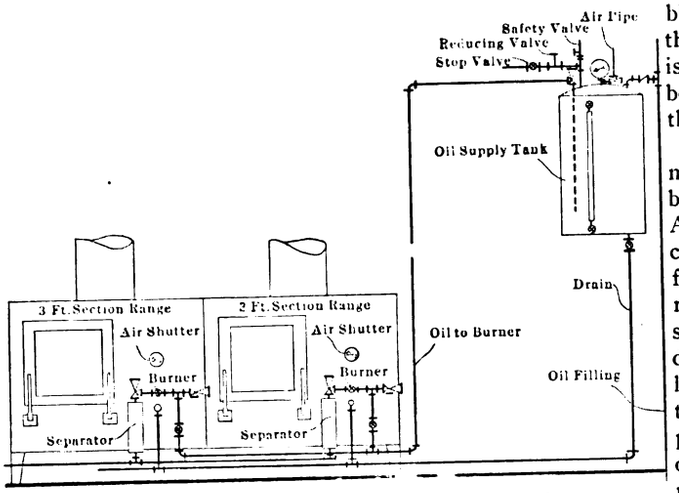
Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Oil-Burning Galley Ranges

The results obtained with a fuel oil-burning range fitted recently in the galleys of a number of the United States torpedo boat destroyers were so satisfactory that this type of range is now being installed on all destroyers which burn oil fuel. The installation consists in modifying the firebox of the Standard range by removing the parts required for coal and fitting firebrick of a special design. A burner having a 1/32-inch opening was developed after



Arrangement of Galley Range for Burning Oil

numerous trials. Steam is used to create the pressure on the oil, and, as it both heats and thins down the oil, there is no trouble regarding the flow. Steam is also used at the burner, being first passed through a separator designed for this installation. The accompanying sketch shows the principal features of the installation as fitted.

A. H. NOURSE.

Navy Yard, Brooklyn, N. Y.

Repairs to a Piston-Rod Gland

The engineer of a tug on the Hudson River recently allowed his fireman to pack a piston-rod gland. In attempting to blow out the old packing with steam, the fireman broke the gland on each side of the rod, so that it was in three pieces. It was impossible to have a new gland cast at the time, so the difficulty was overcome by using a piece of half-inch boiler plate to hold the three pieces together.

The engineer released the piston rod from the crosshead and held it up by attaching a lathe dog to the tail-rod. The piece of the gland on the piston rod was removed and the three pieces clamped together with the piece of boiler plate on the bottom. Holes were then drilled through the boiler plate for the piston rod and studs and through the gland and boiler plate for bolts. There were four holes for bolts, two in the center piece and one in each of the other pieces. These were threaded and countersunk on the boiler plate side. Bolts were then screwed into these holes, cut off about flush on the countersunk side and riveted over to fill the countersink. This was done because of the small clearance. The edges of the plate were ground to the form of the gland, in order to make a neat job, and the gland replaced. G. T. C.

Propeller Corrosion

Propellers, like all other parts of a vessel's hull or machinery, are liable to corrode. This corrosion on propellers is found in the form of pitting on the backs of the blades at the tips. This often goes right through the blades, and in some cases the tips are so weakened that they are thrown off or are wasted away. The corrosion is most severe in cast iron blades, but cast steel is not far behind. Bronze composition blades are the only ones that are comparatively free from this fault.

The causes of this corrosion are many, but the foremost one seems to be due to the propeller backs and tips being exposed to the action of a mixture of air and water. Air causes the pitting in boilers, and in a like manner causes it on propeller blades. The air is drawn down from the surface when the propeller is not wholly submerged, and even when the tips approach closely to the surface the eddies formed are strong enough to draw down the air. This happens when the vessel is not fully loaded or when she is in the ballast condition. The blade tips are also exposed to this action when the vessel is pitching in a seaway and the blades are partly thrown out of the water. This corrosive action goes on at a very much slower rate when the wheel is stationary, and I believe that this is a proof that the air in the eddies back of the blades is the chief factor in causing this excessive pitting.

That this corroded condition of propeller blades is common is seen upon a visit to some of the large repair yards where boats are docked for painting and repairs. It has often been a surprise to the writer to see how far this corrosion is allowed to go on a great many vessels before the blades are changed. Upon inquiry it has been ascertained that some chief engineers consider it very good economy to run upon these blades until the extent of the corrosion is so great as to break the blades, or until the speed of the vessel is materially impaired. This has always seemed such a poor policy that the writer, by means of data available, has gone into the subject, and, while it is almost impossible to reduce the effects of corrosion to actual figures. results have been obtained that are true in a comparative sense, and at the same time check well with theory. In this short paper only results will be given in a general way because the figures would vary to so great a degree that the values in one case would not be applicable to any other case.

As mentioned before, the pitting goes right through the tips of the blades, and so, of course, reduces the area of each blade. In some cases this reduction is considerable. The loss in area means a greater effective thrust per square inch of projected area if the same power is to be transmitted by the blades. To maintain the same speed the effective horsepower must be the same, or, in other

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words, we must have the same total effective thrust. This increase of thrust per square inch of projected area would increase the slip, which in most cases would be accompanied by a drop in the propulsive coefficient, and these two would cause the vessel to slow up unless the revolutions were increased. The loss of area would tend to increase the revolutions, but this could never take place, because the surface friction of the corroded tips is very great. What actually does happen is that the revolutions are decreased by this resistance to turning, and this results in a decrease in the vessel's speed, since speed equals revolutions $\times$ pitch $\times$ (1 — slip). The drop in the revolutions may tend to decrease the slip, but the increase due to loss of area would more than compensate this favorable slip.

Summing up, we find that corrosion of propeller-blade tips has the effect of decreasing the speed of the vessel through lessening the area of the blades, decreasing the revolutions per minute, increasing the slip and causing the propulsive coefficient to drop.

In some cases the corrosion is so severe as to eat away almost entirely the tips of the blades so that the diameter is slightly reduced. The effects of this are different from those due to the loss of area, but the results are almost the same. If the same power is to be transmitted by a propeller of slightly smaller diameter, assuming the area ratio about the same, the revolutions will have to be increased. This would mean an increase in the slip and a decrease probably in the propulsive coefficient, and, with the same power, a slight decrease in speed, due to the latter. However, as before, the revolutions cannot be increased. due not only to the high surface friction of the pitted blades, but also due to the greater thickness and breadth of the tips at the tip section; the real tips being corroded away. This means that the revolutions will be decreased, and therefore the speed of the vessel reduced, beyond the reduction due to the increased slip and decreased propeller efficiency mentioned above. In the case of the broken-off or corroded-away tip the reduction in speed is naturally greater than that when only the area was reduced, due to the pitting. This is consistent, because the slighter the corrosion the slighter the effect.

As mentioned before, cast iron blades offer the poorest resistance to corrosion, and it has been recommended time and time again that their use be discontinued except for special purposes. Steel is little better than cast iron, but its greater strength allows it to be made less heavy, and therefore more efficient. Bronze or compositions are the only logical materials for propeller blades. These metals may be cast with very smooth surfaces and sharper edges with less tip thickness, because of their strength, and also because no extra thickness has to be added to allow for the wasting away due to corrosion. Zinc plates. however, must be placed upon the vessel's hull to prevent galvanic action.

All the above-mentioned points add to the propeller efficiency, and this, coupled with less weight, means a saving in running costs.

Detachable blades are, of course, preferred for merchant work, and this means a bigger loss than when solid propellers are used. However, since the function of a boss is to form a means of attachment for the blades, it needs only be large enough to do this in an efficient manner, and why such large and heavy bosses are fitted in so many cases is hard to understand. The writer knows of cases where otherwise good propellers have been spoiled by their large and heavy bosses. A large boss is hard to turn and causes great eddy resistance, thereby causing the blades to work in disturbed water, which causes vibration. The extra weight puts the tail shaft under a greater stress than necessary.

The only argument one has against bronze blades and good propellers is first cost, but let engineers look into the upkeep and running cost necessary to maintain maximum efficiency and the writer believes more old propellers will find their way to the scrap heap.

Brooklyn, N. Y. F. K. RUPRECHT.

Repairs to Air Compressor Cylinder of Refrigerating Ship

The cold storage plant of a refrigerating ship is of the greatest importance to the ship, more important even than the propelling machinery, for the shutting down of the propelling machinery for repairs, while perhaps an annoyance, does not involve any risk to the cargo as long as the refrigerating plant continues to be in good condition. When, however, occasion arises to make repairs at sea to the refrigerating plant of a ship carrying fresh or frozen meats, the urgency for quick action is borne in on everyone concerned. The plant must be placed in operation as quickly as possible.

On a ship of 8,000 tons and 1,800 horsepower a cargo of 600 tons of frozen meats, besides quantities of butter and eggs, was carried. The meat holds were kept at temperatures of from 15 to 18 degrees F., while the butter and eggs were carried in compartments where the temperature was kept at 30 degrees F. It was necessary to keep the butter and egg compartments constantly as nearly at this temperature as possible, not varying more than a degree or two if the best results were to be obtained.

The ship operated in tropical waters, where the heat of the sun on the decks and sides of the ship, and the high temperature of the sea water, caused a rapid rise of the temperature in the cold rooms if the refrigerating machinery was shut down for any length of time. Even while running, great care was necessary to distribute the cold air in the various compartments in order to maintain them at their proper temperatures.

The refrigerating machinery consisted of two Hall & Haslem machines of the horizontal steeple compound type, which compressed the air to 60 pounds pressure, and after expanding it down to atmospheric pressure, exhausted it into trunks, or ducts, that conveyed it to the cold rooms, where it was discharged directly into the compartments on one side of the ship, the return air being drawn back to the machine through similar trunks on the opposite side of the ship. On the proper circulation of the air across and through the compartments, much depended for the success of the refrigeration, the other important element being the quality of the air—that is, its temperature and dryness.

The efficiency of all compressd air refrigeration depends largely on the dryness of the expanded air, but particularly so in this system, where the expanded air is exhausted directly into the cold rooms and comes in direct contact with the cargo. The compressed air passed through a dryer on its passage from the compressor to the expander, the moisture held in suspension in the air being precipitated to the bottom of the dryer and drained off. An excess of moisture in the air caused the ports and passages of the discharge valves of the expander to clog up with frozen snow and the snow to be carried along and deposited in the trunks, passages, openings and cold rooms, from which it was removed with difficulty, to say nothing of the injurious effects on the eggs, which re-

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quire for their best preservation not only air of constantly even temperature, but air of exceptional dryness and free of moisture.

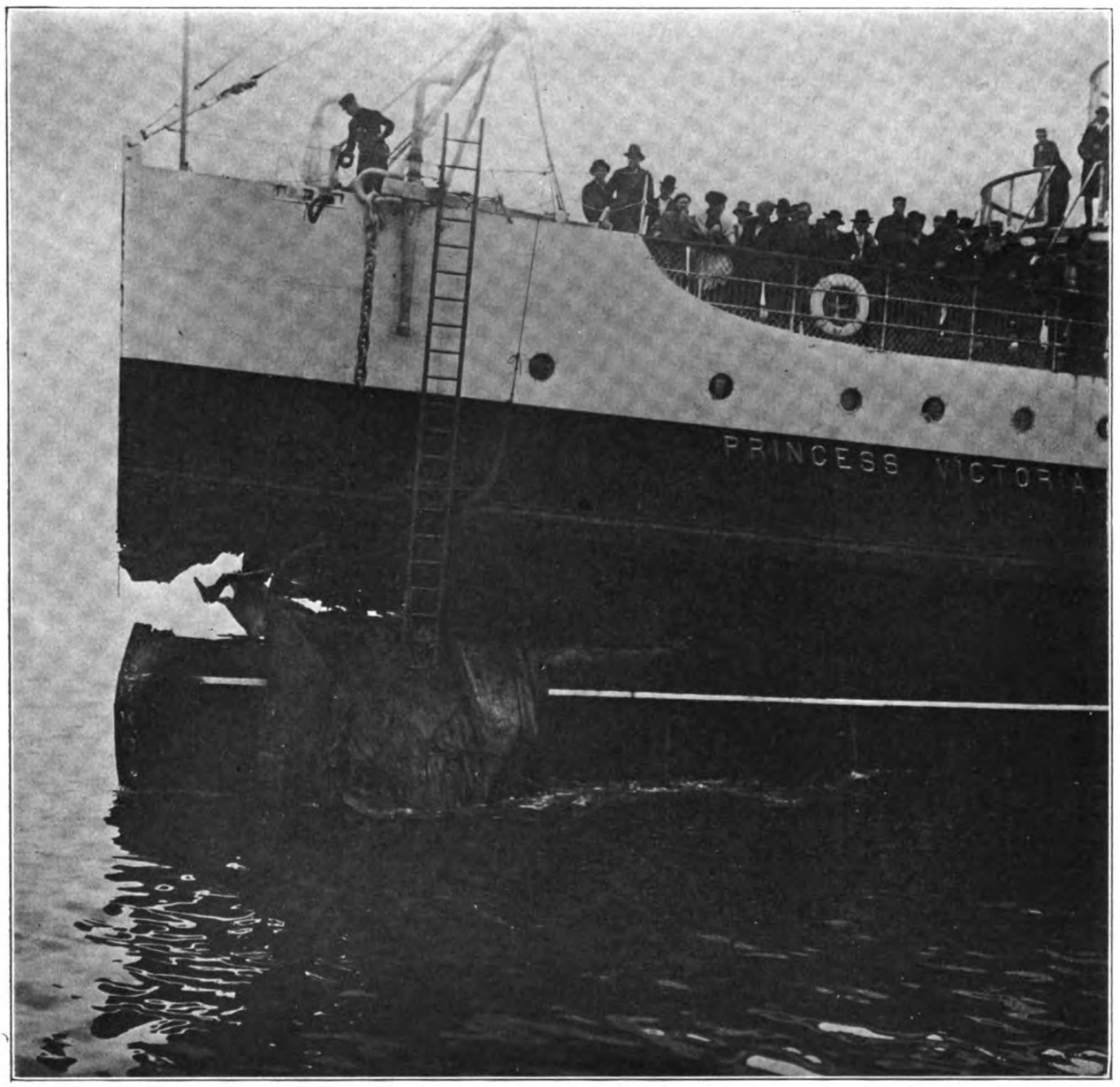
The trouble due to moisture held in suspension by the compressed air, and not wholly precipitated and removed in the dryer, is never entirely lacking in this system of refrigeration, but a considerable increase over normal in the amount of snow deposited in the trunks and exhaust valve passages led to an investigation as to the cause.

The air compressor cylinder wall and heads were jacketed for water circulation. Clearance depressions for nuts on piston rods projected into the water jacket, and the circulation of the water had worn and eroded away the metal on these projections until the water entered the air compressor cylinder on each air suction stroke and was present in such quantities as to freeze and block the ports and passages of the exhaust valve of the compressor. Repairs were made as follows:

The piston was removed from the cylinder and the projecting bosses in the water jacket bored out. Brass pieces were machined with depressions for the nuts, as before, and with a small flange. These pieces were driven in the head and further secured with a 5/16-inch machine screw through the flange into the head. The follower plate of the air compressor piston was counterbored to provide clearance for the flange projection. A water pressure was put on the jacket and, everything being tight, the machine was assembled and no further trouble was experienced from excessive moisture in the compressed air.

J. E. CLEARY.

Philadelphia, Pa.



Damaged Bow of the Steamer *Princess Victoria* after Sinking the *Admiral Sampson* near Seattle, August 26

Damage to the S. S. Princess Victoria

The unusual photograph accompanying this letter shows the damage done to the fast Canadian Pacific passenger liner *Princess Victoria* when she collided with and

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sank the Alaska liner *Admiral Sampson* in dense fog in Puget Sound early on the morning of August 26, resulting in the loss of 11 lives. While other marine disasters in North Pacific waters have claimed more lives, few have resulted in heavier financial loss. The *Admiral Sampson*, a well found vessel of 1,336 tons net, was fully loaded with a valuable cargo and had 75 passengers for Alaskan ports. The *Princess Victoria*, which plies between Seattle and Victoria and Vancouver, B. C., has been libeled for $670,000 (£137,000), of which $500,000 (£102,500) represents the value of the *Admiral Sampson*. $150,000 (£30,800) the value of her general cargo, and the balance for baggage, etc.

When the *Princess Victoria* struck the *Admiral Sampson* on the port side abreast the after hatch, she cut many feet into the Alaska liner, inflicting a wound which caused the American steamer to sink in less than ten minutes. The photograph shows a portion of the *Sampson's* hatch combing and a part of the hatch cover held fast in the gash made in the *Victoria's* bow.

The accident occurred shortly before 6 o'clock in the morning, and the fact that but three passengers and eight of the *Sampson's* crew were lost speaks for the excellent discipline and splendid seamanship displayed. The *Victoria* picked up all the survivors found and arrived in Seattle unassisted. The *Admiral Sampson* was for years engaged in the fruit trade between New York and the West Indies.

R. C. HILL.

Seattle, Wash.

An Oiler's First Experience at Sea

Upon leaving school before graduation time, the writer determined to continue his marine studies practically and see a few things before settling down ashore. With that idea I was fortunate, considering the season and my ignorance of things below, in landing a berth as oiler on a lake-style collier. She was not new, but the three engineers joined her at the same time, and so she was new to them. She carried no third assistant then.

As usual in such steamers, the after ends of the boilers helped form the forward end of the engine room. As I understand it, the underwriters do not require such vessels to install any bulkhead whatever between the boilers and engine room, thus allowing many of the boiler fittings to be installed in the engine room under direct control of the engineer.

Trouble started from the first. Someone pumped bilge water into the fresh-water tank, and we drank mud for a couple of days. As soon as the first load of coal was stowed the rudder-post started to leak a small, steady stream. Attempts were made to stop the leak, but it could not be done. Then the bilge pumps refused duty and were repeatedly overhauled; but probably because the seat of the trouble was not looked for, they still balked. Next, one of the ash hoppers got out of order and repeatedly washed ashes into the bilges. As far as I remember, the other hopper was mostly ornamental. But both had their doses of overhauls, which, of course, made things worse, instead of better.

This was all fine experience for a school-boy looking for such; but it was pretty plain to see that no time was given us in port to have things fixed up properly, since it was always a case of rush to get in and rush to get out.

Things went along like that for a few trips, when one night, north-bound, the 8—12 watch got tangled up with the ash hopper and washed the ashes from four fires into the bilges. As I said before, the bilge pumps were not performing and the ballast pump was put on that job until the proper pumps could be overhauled again. The 8—12 watch fixed things up the best they could, and left the second assistant and me in charge.

About 1 A. M. I notified the second assistant that the bilge water was not being pumped out, although the pump was working. He and I worked on the pumps; but still the water rose. The first assistant was called, and got to work on the ballast pump. Bonnets were removed and replaced, again removed and replaced, the result being a fine collection of rags, waste, nuts, clinker, coal, sticks, etc., enough to block the injection.

By the time the pumps were cleared the fireroom floor plates were washing around and the bilges were filling up with bunker coal. However, the bunker openings were soon stopped up, but not until all the bilge suctions were hopelessly clogged. This made it necessary to remove manifold bonnets and break flange connections—all under water—to let the pumps work. When we started on those jobs the water was like ink and comfortably warm. The course had been changed to the nearest harbor, bringing the sea abeam and throwing the water around the engine room like a tropical rainstorm. When the emergency suctions were finally opened the water was as black as it could get, too hot to put a foot into, and over the engine room floorplates—about 3½ feet deep. At first, tomato cans with holes in the ends were used as strainers, but finally some heavy gauze was dug out, and the cook let us have his toaster. Then we bailed by hand into the manifold, while the pump did its little through the cook's toaster. It was quite a job to keep the strainers clear, and when we anchored after making twenty-three miles in nine hours, the water was about half out.

The sailors were nearly all landsmen, and had been put to work in the fireroom to help keep steam. They stuck to their job in fine shape, although they were washed around like corks and bruised by rolling lumps of coal. No Ethiopian was ever blacker than we were when it was time to wash up.

The water service had been shut off early in the fun; but still the water poured in. It came only from the leak in the rudder post, and the leak left in the hopper when the other watch finished overhauling it. The bunker coal got into the bilges because the floor plates were not screwed down. Loose planks were the only means provided to keep coal in the bunkers and out of the fireroom, and the openings themselves were large. There was an absolutely clear space from the bulkhead between the fireroom and the hold to the after-peak tank, allowing anything getting into the fireroom bilge to be washed to the suctions under the thrust.

Needless to say, as soon as the cargo was discharged we went to dry-dock for repairs; but the stern-post still leaked when the next cargo was dumped into her. If there is a lesson to be gained from this experience, it might be that haste makes waste with things afloat as well as with things ashore.

OILER.

DUTIES OF CHIEF ENGINEERS OF VESSELS PASSING THROUGH THE PANAMA CANAL LOCKS.—According to an order issued on August 14 by Col. Goethals, governor of the Canal Zone, in future in addition to the regular engineer officers of the watch, the chief engineer of all ships shall remain on duty in the engine room during the approach of the vessel to and while passing through the Panama Canal locks. It shall be his principal duty to see that signals from the bridge for the operation of the engines are understood and correctly and promptly answered.

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Marine Articles in the Engineering Press

Abstract of an Important Article on Suction Between Passing Ships—Details of Some of the Large Shipyards and Engine Works in Great Britain

The Handling of Coal at the Head of the Great Lakes.—By G. H. Hutchinson. The author traces briefly the growth of the handling of coal on the Great Lakes and gives step by step the gradual development of the mechanical coal-handling devices from the simple beginning to the present elaborate installations. Various installations and methods of handling, etc., are described and a brief comparison of the electrically operated plants of 1902 and 1913 are given, concluding with a description of various clamshell buckets, methods of screening and reloading for rail shipment, together with the conditions relating to the handling of coal. 41 illustrations. 11,300 words.—*The Journal of the American Society of Mechanical Engineers,* August.

Safety at Sea.—By Captain Armistead Rust, U. S. Navy. In discussing accidents at sea, particularly the *Empress of Ireland* disaster, the author proposes a plan to systematize navigation, which in his opinion would provide greater safety than any attempts to build unsinkable ships. The system involves the establishment of a series of tracks for oppositely bound ships with a *safety zone* between; this, together with cross courses, forming *danger zones,* and a convenient and simple system of nomenclature plotted on the chart, further involves the use of a low-powered wireless apparatus for use in transmitting the vessel's location, according to the chart, giving her direction and speed. By the use of a suitable standard code and chart, as proposed, this message would consist of about six figures following the *zone letter;* in fact, on special occasions the *zone letter* is sufficient. An appendix includes extracts from the report of the Commission of Inquiry into the casualty to the British steamship *Empress of Ireland,* which sank after collision with the Norwegian steamer *Storstad,* in the St. Lawrence River, on May 29, 1914. The article also includes a description of a substitute for Lord Kelvin's sounding tube, which gives very satisfactory results and is inexpensive. 1 illustration. 6,000 words.—*United States Naval Institute Proceedings,* September-October.

Some Swedish and Danish Oil Engines.—The Hexa marine oil engine, introduced into England by the firm of Sophus Berendsen, Ltd., London, works on the hot bulb principle. The main bearings, which are fitted with ring lubrication, are entirely outside the crank cases, so that they can be easily adjusted and compression is not affected by leakage from worn bearings. Another interesting feature of the engine is found in the design of the fuel pump, which is operated through a bell-crank and eccentric off the crank-shaft. The end of the bell-crank carries a sliding block which engages with the pump plunger. The slide, however, has a small inclined portion, so designed that, at a certain speed the sliding block, by virtue of its momentum, will be thrown up too far to engage with the pump plunger. A four-cylinder, four-cycle engine of 42 brake horsepower is also described and, because of its overhead valve arrangements, approaches Diesel engine lines in general appearance. An interesting feature of this design is in driving the pumps by rocker arms off the connecting rod. Two other types, handled by the same firm, are described, but neither presents any features that vary greatly from regular practice. The first, a Diesel type, has an air compressor similar to those of Messrs. Burmeister & Wain. The last engine described is of the L-head, four-cycle, hot-bulb type, designed for agricultural work. 10 illustrations. 1,780 words.—*The Engineer,* September 18.

Suction Between Passing Ships.—By Sidney A. Reeve, M. E. Defining suction as three distinct and independent hydraulic phenomena associated with moving vessels and tracing its historical development as such, the author explains why suction has not been given as the cause for various collisions. To warn pilots, however, as to the general conditions under which suction is liable to occur and as to where a larger margin of caution than usual is needed, the author discusses briefly the various parts of theoretical hydraulics necessary to give a qualitative understanding of the forces at work in suction. This discussion consists essentially of a study of stream lines, sources and sinks, showing that the source-and-sink method can be used as an exact analysis of the displacement of the sea by a passing vessel. The author's connection with the development of the theory of suction began when he used two diagrams, one on transparent cloth, investigating merely the general outline of the constrained wave. The one on transparent cloth was moved over the other to show how the suction forces were developed by these two outlines getting into and out of place. To strengthen the belief of this theory the case of the *Olympic-Hawk* collision was virtually predicted by a naval officer who was a passenger on the promenade deck of the *Olympic* and who had previously listened to a lecture by the author on the subject. To further study the subject it becomes necessary to outline ship waves and sea contours. In explaining the constrained wave, which is practically the cause of all suction collisions, it is easily seen that while almost invisible it is by far the most powerful force created by the ship's motion. In general, then, through the center of the ship's displacement are drawn two lines at 45 degrees to the ship's center line, forming quadrants fore and aft and one on each beam. Asymptotic to these lines are the approximately hyperbolic mean sea-level contours, due to the elongated form of the vessel. These hyperbolas extend indefinitely away from the ship, but all other contours are closed curves. Between the limbs of each hyperbola, ahead and astern of the ship, rises an oblique cone of water at the stem and stern. On the other hand, the depression beamwise is still more marked in extent, and it is probably this wider area of depression than of elevation that has given the name suction rather than repulsion to the phenomenon. It is also noticeable that the deepest depression does not occur directly abeam, but on both bows or quarters, where occurs a deep pocket. In explaining the interaction between two or more ships, the author describes two methods whereby this interaction may be studied graphically. This is done by superposing two diagrams, the one on the other in their relative positions on parallel courses and one overtaking the other, so that a combined set of sea contours is obtained showing the conditions met with by such an occurrence. The two methods are similar in respect to superposing,

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but slightly different with respect to initial assumptions and amount of overlapping. Both show graphically, however, why collision is almost inevitable under the conditions outlined. For instance, ships might continue safely on fairly close overlapping courses, but the conditions accentuating the forces, rendered innocuous by a great depth of water, are those of a fairly sudden shoaling, the passing of a third ship, or some restrictions such as a pier, etc. These conditions obtain in practically every case, and to illustrate the point the author's concluding remarks are analyses of actual cases showing the conditions obtaining. By giving data that may reasonably be relied upon, it is shown that such a study, as outlined, helps materially in warning pilots as to what should be avoided, and, further, a more formal and reliable preventative in the form of an amendment to our international navigation laws covering the case of overtaking vessels. 16 illustrations. 22,300 words.—*Engineering,* August 7, 14 and 21.

Föttinger Hydraulic Transformer on the S. S. Königin Luise.—The S. S. *Königin Luise*, sister ship to the S. S. *Kaiser,* a direct turbine-driven ship, was fitted with high-speed turbines and Föttinger transformers, so that the propeller speed was 450 revolutions per minute when those of the turbine were 1,800, developing 2,745 horsepower in each turbine. The rotor of the steam turbine consisted of a Curtis wheel followed by a drum carrying thirty-two reaction stages divided up into seven groups. A centrifugal governor was fitted in connection with a servo-motor, and as a final measure of security an emergency governor of the shaft type was provided. While the general design of the transformer is the same as has often been described, there are several details that greatly simplify the assembling of the gear. There is only one secondary wheel and only one set of guide blades between this wheel and the reversing primary wheel. The simplification was possible owing to the small ratio of transformation, 4 to 1. The ratio of ahead to astern power was 70 percent. The first ahead secondary wheel, and with it all primary and secondary wheels, were made in one piece, which permitted a very simple method of erection. After a detailed description of the transformer and its operation, the main steam and water connections throughout the system are described with the help of a diagram of connections. A very complete table is given showing the heat distribution, horsepowers, efficiencies, etc. In conclusion the article gives a table showing a comparison of the main particulars and trial data, etc., for three other vessels and the *Königin Luise*, all having different forms of turbine installations. 6 illustrations. 3,500 words.—*The Engineer,* September 11.

Emergency Repairs to U. S. S. Walke.—By Lieut. Commander F. T. Evans, U. S. Navy. After the passage of the reserve torpedo flotilla, U. S. Atlantic Fleet, from New Orleans to Garden Key in March of this year, it was discovered that the after trimming tank of the *Walke,* Second Division, was carrying a heavy pressure of air, as shown by the leakage of air around some rivets in the deck of that compartment. Examination by a diver showed that there was a jagged hole in the bottom of the adjacent compartment about a foot and a half long and a foot wide, situated abaft the forward strut and between its legs. It was decided to pump out the compartment, after covering the hole with a collision mat, drill the plating around the hole and bolt on a patch. All of this was successfully carried out except the use of a collision mat, which failed because the hole was situated so close to the struts that a good placement was impossible. A wooden patch was made, however, 24 by 33 inches, of double-crossed inch boards and padded on its bearing surface with several thicknesses of "fear-naught," which in turn was covered with two thicknesses of No. 8 duck. The time for the actual repairs was about thirty-one hours. 4 illustrations. 1,740 words.—*United States Naval Institute Proceedings,* September-October.

Typical Ships—An Oil Tanker.—The vessel chosen to illustrate the oil tank class of ships is the *San Jeronimo,* which has just been built by William Doxford & Sons, Ltd., of Sunderland, for the Eagle Oil Transport Company, Ltd. The ship is 525 feet long by 66 feet 6 inches beam and 34 feet molded depth, and has a deadweight carrying capacity of 15,570 tons on 28 feet draft. Built on the Isherwood system, the vessel is divided transversely into twelve tanks, which are further divided by a longitudinal centerline bulkhead, making twenty-four tanks for carrying bulk oil. In addition there are fourteen summer tanks spaced along the side of the expansion chamber. There are two main pump-rooms, acting as cofferdams, dividing the ship and the twelve tanks into three distinct groups. The machinery space is aft and the propelling machinery consists of one quadruple expansion engine of 4,300 indicated horsepower, giving a speed of about 11¾ knots. Steam is supplied by four boilers working at 220 pounds pressure and burning oil on the Wallsend system, combined with Howden's system of forced draft. A special feature of the *San Jeronimo* is the provision or arrangement to carry oil of the lowest flash-point with safety. 4 illustrations. 3,100 words.—*The Engineer,* September 4.

Australian Ports in Relation to Modern Ships and Shipping.—Abstract of a paper, by W. E. Adams, A. M. Inst. C. E., read before Section G of the British Association in Australia. The paper reviews the position of shipping from the standpoint of harbor authorities and commercial interests involved. Considering the enormous increase of shipping, particularly in the size of ships, the situation presents quite a problem to the port authorities of Australia, and one that calls for careful consideration. The conditions upon which the improvements depend are outlined and discussed, and to better understand the situation a comparison is given of the berths of fifteen years ago at the port of Sydney with those of to-day. Two cases of jetty construction, as tried in Sydney, are briefly described. These types are designed to meet the conditions where space is not available for longshore wharves served by low-level roads and belt railways. The author states that, though important, the class of wharf construction that will come into use in the future is very uncertain at the present time. 1,950 words.—*Engineering,* September 18.

The German Naval Architects.—At the summer meeting of the German Naval Architects, opened on May 27 at Stuttgart, the first paper read was on *Guns and Armor,* by Professor J. Rudloff, of Berlin. This paper reviewed the contest between guns and armor, and the author noted that the all-big-gun system was being given up again in favor of that of a combination of larger and smaller guns, which Germany had never abandoned. It was also pointed out that, due to the greatly increased power of the torpedo, it was anticipated that the naval battles of the future would be fought at greater distances. In a discussion of the paper it was expressed that fire superiority was the one factor of importance. It was also stated, as an argument in favor of large calibers, that large sizes of projectiles show less tendency to ricochet than smaller ones. *Experiments with Case-Hardening.*—The object in view was the combination, in a working part, of a tough core of metal encased in a sleeve of harder but brittle metal by the

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superficial addition of carbon to the parts subject to wear, and an investigation as to how far the one quality suffered at the expense of the other. In conclusion the author recommended testing for particular cases to ascertain whether case-hardening or the choice of a special steel material would be more suitable for parts subject to considerable wear. A second paper, by the same author, on *Tension and Alteration of Form in Riveting in Relation to Hole Cracks,* showed that the application of excessive pressures by means of hydraulic riveters might even reduce the desirable pressure tending to bring the plates together. On May 28 the society visited the Zeppelin Works at Friedrichshafen, where the aluminum framework of a new airship was inspected and a paper was read by Count von Zeppelin on *Zeppelin Airships.* In tracing its development, the author stated that the rigid system of holding the structure together seemed to be unavoidable, and was therefore adopted. The structure, however, was considerably lightened by adopting two cars to carry the weight instead of one, which would concentrate the weight and necessitate a stronger and consequently a heavier structure. A comparison between airships and aeroplanes showed the superiority of the latter at 56 miles per hour and over, pointing out that aeroplanes traveling over long distances at low speeds were especially subject to retardation by contrary winds and that for very long distances the airship was superior to the aeroplane. An important question and one yet to be solved is that of a non-inflammable gas to take the place of hydrogen now used. A paper on *Steam Shipping on Lake Constance,* tracing its rise and development since the pioneer vessel made her first voyage ninety years ago, together with a paper on the establishment and development of the *Stuttgart Laboratories* and a description of the same, both by Fregattenkapitan Collman, concluded the programme. 7,200 words. —*The Engineer,* June 5 and 12.

French Sea Fisheries.—The productivity of the French sea fisheries is far inferior to that of the same industry in Great Britain, largely due to the circumstance that the French industry still remains in a very primitive condition from the standpoint of the craft employed. Nevertheless, these fisheries have developed remarkably at certain points on the coast, occupying a prominent place in the activities of the ports and supplying, to an important extent, the traffic on the French railways. The industry has for a long time received encouragement in the form of premiums for deep-sea fishing, chiefly cod-fishing. This, however, has caused a decline, while the fishing for fresh fish, unassisted by subventions, has developed remarkably. Statistics quoted each year by the French Admiralty Board show that since the commencement of the nineteenth century the industry has developed remarkably, but the development now reached is in no way comparable to the advances made either in the same country forty or fifty years ago, or to those which are being, and have been, made in other countries. The boats, speaking generally, are only slightly improved, because they are the property of small owners, who do not have the required capital necessary to adopt machinery or to construct larger units. The total number of boats employed in French sea fishing is about 30,000, and at the present time only 270 to 280 of the whole fleet are steamboats. The steam fleet comprises three types—the trawlers, the line fishing smacks and the drifters. The trawlers are generally constructed of iron, and are of 300 to 400 gross tons, fitted with 400 to 600 horsepower. These are usually provided with holds containing ice, although, more rarely, refrigerating apparatus. These boats are still frequently constructed in England for French owners. In order to diminish first cost, certain boats have been fitted with internal combustion engines up to 200 horsepower, to actuate the screw, with the same type of engine up to 30 horsepower, to work the capstan. In conclusion, while the sea fishing in France is still greatly behind hand, under the influence of the steam trawler it is being industrialized, and there is a gradual introduction of the fixed wage, as adopted in ordinary works on land. Altogether the expenses of the French Government, of subventions, bounties, etc., exceed 21 percent of the value of the total production of this branch of the sea-fishing industry.—2,700 words.—*Engineering,* July 31.

Harbor Construction at Frankfort-on-Main.—Frankfort, though counted among the Rhine harbors, as is also Offenbach, lies on the Main, which drains an area of 10,650 square miles. The canalization of this latter river between Frankfort and the Rhine presented difficulties, there being insufficient depth of water and a considerable fall on this section of the river. After abandoning the plan of constructing an independent canal between Frankfort and Mayence, the Prussian State decided to undertake the work of making the Main navigable for large vessels. This was accomplished by the construction of six weirs, which deal with an aggregate fall of 34 feet 2 inches in 20.5 miles. The regulation allows the passage of vessels of 8 feet 3 inches draft and 1,000 tons capacity, and a further weir has been constructed above Frankfort, so as to make Offenbach also accessible for Rhine craft. When the Frankfort west harbor was built, the city undertook that it should provide a safe harbor for vessels, when this waterway became unnavigable because of the weirs being rendered inoperative by ice or repairs, allowing the vessels to enter even at the lowest water level. Although no such undertaking exists for the east harbor, large portions of it will offer the same advantages to shipping. The entrance to the lower or west harbor first leads into a triangular basin, from which branch off the commercial dock basin and the lower industrial dock basin. This outer triangular basin not only serves as a waiting place and a means of establishing connection between the two dock basins, but it is also used for turning vessels; its dimensions are such that a circle can be inscribed having a diameter of almost 500 feet. The commercial dock basin has a breadth of 246 feet or 7½ ships' breadth, all told, of about 33 feet. The breadth of the industrial harbors, of which there are three, does not require to be so large and is fixed at 131 feet and 164 feet. The harbors as enlarged will have an aggregate wharf accommodation of 8.7 miles in length. Including 3.1 miles of old shore accommodation, Frankfort will thus have about 12.5 miles of wharf accommodation available. All quay and other structural foundations have been laid deep enough to increase the depth in the inner basins from 8 feet 10 inches to 9 feet 10 inches if such should be deemed expedient in future. The quay walls at the entrances and sides of the dock basins are nearly vertical and the foundations are of concrete, the wall on the outer side being coated with basalt, and the crown finished with granite blocks. There are steps at varying distances and ladders between them, so that at least a set of steps or a ladder corresponds with each ship's length. Both steps and ladder are in the quay wall thickness. The railway communications, as well as the connection of the new harbor with the town, are on the same comprehensive basis as the rest and some very important structures also in the way of bridge-building are already more or less advanced. The bridges and viaducts come under two heads—the bridging of the streets

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and railways and the bridges over the Main and the harbor basins. The Frankfort harbor authorities have expressed their determination to make their harbor as complete and efficient as possible. The traffic in 1911 amounted to an aggregate of 1,990,248 tons, against 1,840,704 tons in 1910. 7 illustrations. 2,500 words.—*Engineering*, August 28.

North-Eastern Marine Engineering Company's Works, Wallsend.—The company's establishments, one at Sunderland, where 1,200 men are now employed, and another at Northumberland, where 2,000 men are employed, both carry out the same operations and are assisted by the company's Northumberland forge, which produces per annum about 2,500 tons of forgings of all classes. The average output per annum of the combined concern shows a collective horsepower, of marine engines built, of 95,000. In designing the machinery built every effort is made to adhere to standards, varying only in the power to be developed. The main buildings, at Wallsend, are constructed on a fairly steep slope stretching from the railway sidings to the river. The roof is level and the floor of the shops terraced in three great steps. The location of the various shops greatly simplifies their convergence to the engine-erecting shop, which is laid with a concrete base for the building up of the engines. The practice at the works is to transfer from the erecting-shop to the ship complete triple expansion engines up to 2,000 horsepower. In the case of larger engines, the bed-plate, crank-shaft, connecting-rods, eccentric rods, links and columns are lowered into position first. All cylinders, even in quadruple expansion engines, are placed in one lift. This is made possible by the crane equipment, which is quite as complete as the machinery equipment in the various shops. A 150-ton cantilever crane handles the machinery, etc., alongside the ships, and is capable of lifting loads into two ships lying side by side along the berth. 7 illustrations. 3,500 words. —*Engineering*, July 3.

The New Armstrong Naval Shipbuilding Yard.—The development in the design of warships has necessitated the building of a new yard by Sir W. G. Armstrong, Whitworth & Company, at Walker. While the Elswick Yard, in itself, is adequate for the present and considerable future advance, the width between piers on the swing-bridge, spanning the River Tyne, sets a limit to the beam of vessels built there. The total area of the new site is 83 acres and 4,115,000 cubic yards of earth were excavated so that the yard proper might be on one level. The river frontage is 4,376 feet and it is on the convex side of a bend in the river, enabling the berths to be built almost parallel to the river for convenience in launching. There are nine berths, ranging in length from 1,000 feet to 500 feet. The river was dredged for a width of 100 feet alongside the quay, to a depth of 30 feet, involving the removal of half a million tons of material. The quay wall and the jetties between berths are of ferro-concrete work. To strengthen the keel and bilge blocks in the berths, 4,500 pitch-pine piles 14 inches square were driven to a depth of 18 feet. Traveling tower cranes on the jetties lift 10 tons at a radius of 60 feet and 5 tons at a radius of 120 feet, while the clear height of lift above rail-level is 90 feet. Electric transformer sub-stations are built into the jetties to reduce the length of low-tension leads. The platers' shed is as close to the berths as possible, and the departments for fitting out are arranged opposite the quay wall, where two or three battleships may be simultaneously berthed. Material is conveyed to racks at the rear of the platers' shed, from the railroad, by means of three successive sidings, having inclines of 1 in 30. The molding loft is built over the platers' shed and is 320 feet by 98 feet. To meet the requirements of drilling, which is largely taking the place of punching in connection with high tensile steel, machines are provided for carrying high-speed radial drills capable of completing the work on the longest plates without moving them. The furnaces throughout the shops are all gas-fired. Throughout the works there are about 10 miles of railway track, with nearly 170 points and crossings. 1 illustration. 2,800 words.—*Engineering*, July 3.

The Wallsend Slipway & Engineering Works.—Few, if any, of the engineering factories in the Northeast Coast district have made more rapid progress in recent years, alike in regard to the area of shops and importance of works done, than those of the Wallsend Slipway & Engineering Company. It is a striking fact that, whereas in the first twenty years of the company's history the output was 432,273 horsepower, it has been 1,077,685 horsepower during the past fifteen years. Up to 1896 the largest engines made were of 4,500 horsepower, since then sets of engines of 70,000 to 80,000 horsepower have been completed. The increase in the volume and value of the work done is due to the improved mechanical equipment as well as to the type of work undertaken. As regards the equipment of the works, the largest set of turbine engines yet completed for a British warship was despatched from the Wallsend Works within eleven months from the placing of the contract. Notable changes in the layout of the plant, regardless of the increases in size, are the elimination of the slipways and the substitution of a hammer-head electric crane on the river side for the old 80-ton sheer legs on the Willington Gut jetty. Various additions have been made in the engine shops for dealing with the largest turbines that are ever likely to be designed. One of these is a 60-inch lathe for rotor-turning work, having a bed 66 feet 3 inches in length; this, in addition to the older tool, which takes work 18 feet in diameter and 50 feet long. For the erection and testing of turbines there has been fitted a bed consisting of twenty-three cast-iron girders, of a collective weight of 55 tons, insuring an absolutely true surface. Besides the turbine work, the firm shows the same progressiveness in the construction of Diesel engines, and both triple and quadruple expansion reciprocating engines. The boiler shop has also been extended. Twenty years ago the average number of boilers per annum was 30; now the number is 77. As to the equipment, the plate-edge planer takes plates 35 feet long and the vertical bending rolls deal with plates 12 feet 6 inches wide, while the hydraulic riveting machine has a gap of 12 feet. Another addition is a 6-inch spindle, high-speed drilling machine, for nickel-steel plates. At the end of the boiler shop there has been built an annex for electro-zincing boiler tubes. This plant includes a three-phase motor and special dynamo by Messrs. Clarke, Chapman & Company. The iron foundry deals with castings up to 30 tons. An interesting feature is that, although the works are entirely run by electric current from the public supply works, the recently built shops are lighted by high-pressure gas, one advantage being a steadier general illumination. The jetties built along the river front on each side of the graving dock take ships 800 feet long, while the hammer-head crane, built by Sir W. Arrol & Company, has sufficient outreach to command two ships of fairly wide beam. The railway lines to the jetties pass through all the shops, so that the transport of material to the ships is a simple matter. 8 illustrations. 2,300 words.—*Engineering*, July 3.

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New Books for the Marine Engineer's Library

A German Author Discusses the Strength of Ships—Notes on Refrigeration—An Elementary Manual of the Steam Engine

THE MODERN WARSHIP. By Edward L. Attwood. Size, 4¾ by 6½ inches. Pages, 146. Illustrations, 17. Cambridge, 1913: The University Press and New York, 1913: G. P. Putnams Sons. Price, 40 cents.

As one of the Cambridge manuals of science and literature, this book shows briefly how a modern warship, costing, say, two millions sterling, grows in the short space of six hundred days from a design on paper to a powerful unit in the navy. The book is written from the naval architect's point of view by a member of the Royal Corps of Naval Constructors, and will be of much interest to the lay reader who desires to obtain a general knowledge of a modern warship. For scientific information on the same subject, the reader should consult Mr. Attwood's standard text-book on warships.

FESTIGKEIT DER SCHIFFE (Strength of Ships). By Felix Pietzker. Size, 6⅛ by 9½ inches. Pages, 224. Illustrations, 140. Berlin, Germany, 1914: Ernst Siegfried Mittler & Son. Price, $2.00.

The author has set himself the task of showing how far calculations can nowadays elucidate the strength conditions of ships' hulls and what practical conclusions can be drawn therefrom. He devotes the first third of the book to the fundamental laws of strength of materials, as applicable to ships, and the last two-thirds to practical applications of these laws, aiming particularly to make clear how far calculation is possible and to what degree of accuracy. In detail the first part is divided into six chapters, dealing successively with methods of applying laws of strength of materials; fundamental conceptions of structural material of ships; equivalent girder of ships; surfaces loaded by water pressure; quality of material and riveting. The second part is in turn devoted to longitudinal and transverse main framing; special requirements of docking; members locally strained by water pressure and local forces and weights. The book is very clearly arranged with a large number of thoroughly practical examples, ably supplemented by the diagrammatical illustrations, which should make the little volume a handy guide and reference book to the designing naval architect. The publishers have assisted the author in producing a book of value by well executed tables and diagrams, clear print and good paper, that compare very favorably with other technical books.

HENDRICKS' COMMERCIAL REGISTER OF THE UNITED STATES FOR BUYERS AND SELLERS. Twenty-third edition. Size, 7½ by 10 inches. Pages, 1,600. New York, 1914: S. E. Hendricks Company. Price, $10.00

The twenty-third annual edition of Hendricks' Commercial Register of the United States for Buyers and Sellers, which has just been issued, is by far the most complete edition of this useful work that has been published. Many new features have been added; thousands of trade names and titles of identification have been inserted, and numerous duplications expunged. "The Assistant Buyer," formerly published by the Sullivan System, has been incorporated with it, and the entire work has been thoroughly revised and improved in every detail. This publication lists manufacturers of everything made from iron, steel, brass, bronze, copper, aluminum, platinum, zinc, lead, etc., whether cast, rolled, drawn, pressed or forged, including bar, plate, sheet, wire, structural and other shapes; pipe, tubes, bands, hoops, high speed, high carbon, tool and other high grade steels, bolts, nails, nuts, rivets, screws, rods, spikes, chains, shafting, etc., and castings of every description, from all metals, including every machine, tool, furnace, etc., required in their production. It numbers some 1,600 pages and contains about 350,000 names and addresses, with upwards of 45,000 business classifications, while 138 pages are required to index its contents. It is used extensively throughout the United States and many foreign countries for purchasing purposes by corporations, governments, associations, manufacturers, exporters, puchasing agents and sales managers.

THE POCKETBOOK OF REFRIGERATION AND ICE-MAKING. Sixth edition. Edited by A. J. Wallis-Taylor. Size, 4½ by 6¼ inches. Pages, 215. Illustrations, 37. London, 1914: Crosby, Lockwood & Son. Price, 3/6 net.

In recent years refrigeration has become an important feature of modern passenger and freight ships, particularly in those which carry perishable cargoes, and the marine engineer is constantly in need of information regarding the general principles of refrigeration and the operation of refrigerating machinery. In this connection this handbook will be found useful, as it presents such information in condensed form for ready reference. The book is divided into six sections dealing with refrigeration in general, cold storage, ice-making and storing ice, insulation, testing and management of refrigerating machinery and general memoranda, tables, etc. Some sixteen pages of new matter have been added to this edition, as well as several new illustrations.

ELEMENTARY MANUAL OF THE STEAM ENGINE. By Ernest V. Lallier. Size, 5 by 7⅝ inches. Pages, 266. Illustrations, 102. New York, 1913: D. Van Nostrand Company. Price, $2.00 net.

In order to help students of steam engineering who lack practical experience, and operating engineers who lack theoretical instruction, the author has compiled a manual which presents the fundamental principles of the use of steam and steam engines in an elementary manner. While the book was written for a special class of readers, the author's experience as an instructor in engineering has made it possible for him to accomplish his task in a very efficient manner. The subjects covered are reciprocating steam engines, governors, engine calculations, the indicator, heat, boilers, pumps, Corliss engines, pipes and fittings, rotary engines, internal combustion engines and lubrication. Numerical examples are used freely throughout the book, and at the end of each chapter are representative questions which will enable the reader to gage his knowledge of the text.

THE TECHNICAL PAPERS of Ariya Inokuty, professor of mechanical engineering in the College of Engineering, Tokyo Imperial University, and professor in the Naval Staff College of Japan, have been compiled and published by the Celebration Committee for the occasion of Prof. Inokuty's twenty-years' occupancy of the chair of engineering, Tokyo Imperial University. Thirty-two papers have been printed in English and eleven in Japanese, all profusely illustrated, and published in a handsome volume of some 600 pages. The volume is a lasting memorial to Prof. Inokuty's great technical genius and a fitting tribute to a life of inestimable usefulness.

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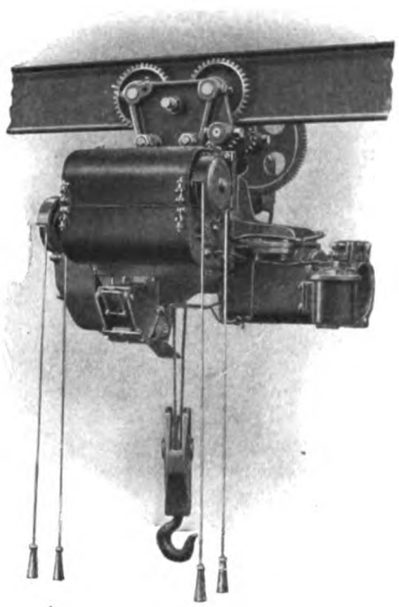
ENGINEERING SPECIALTIES

Traveling Electric Hoist

A traveling electric hoist designed to handle all kinds of material of every weight, size and description, in and about manufacturing plants, is being manufactured by the Pawling & Harnischfeger Company, Milwaukee, Wis. Even where large cranes are used, the hoist, which runs on the lower flanges of an I-beam attached to the ceiling or supported by frames, has the advantage of getting into corners or irregular areas which cannot always be reached by a large, heavy crane.

The hoist is symmetrical in appearance, the drum being in the center, surrounded by a frame of cast steel with the motor fastened to one side and the gear case to the other



side. The drum is flanged and provided with grooves to a depth equal to the diameter of the rope, so that the rope is not apt to jump the grooves if the pull becomes sidewise. The rope is of plow steel, designed with a factor of safety of five. The lift, for type V, as illustrated, is 15 feet, unless otherwise specified. The hoist gears and the load brake are enclosed in a dust and oil-tight gear case and thoroughly lubricated by splash oil. Worm gearing has been avoided and the drive consists exclusively of spur gears. All gears are of cast steel, all pinions of forged steel hardened, and all bearings are bronze bushed. The load brake runs at a moderate speed and is so located that the fewest number of parts are interposed between it and the drum. The load is claimed to be automatically sustained at all times, so that it cannot run down through carelessness of the operator or interruption of the current, but must be let down by reversing the motor.

The truck is bolted to the cast steel drum frame and is provided with drop-forged and roller-bushed truck wheels. On motor-driven trucks, all four truck wheels are driven, which facilitates running over short curves. A substantial, asbestos-lined, clam-shell solenoid brake is provided for the purpose of bringing the motor to a prompt stop after the controller has been returned to the off-position. If this motor brake were omitted, it is claimed that the hook, after the power is shut off, would drift to such an extent as to make accurate spotting of the load impossible. When the bottom block reaches the highest position it strikes a limit switch which interrupts the motor current and brings the motor to a quick stop by means of the motor brake. The load cannot, then, be hoisted any further, but it can be lowered in the usual manner and the limit switch resets automatically.

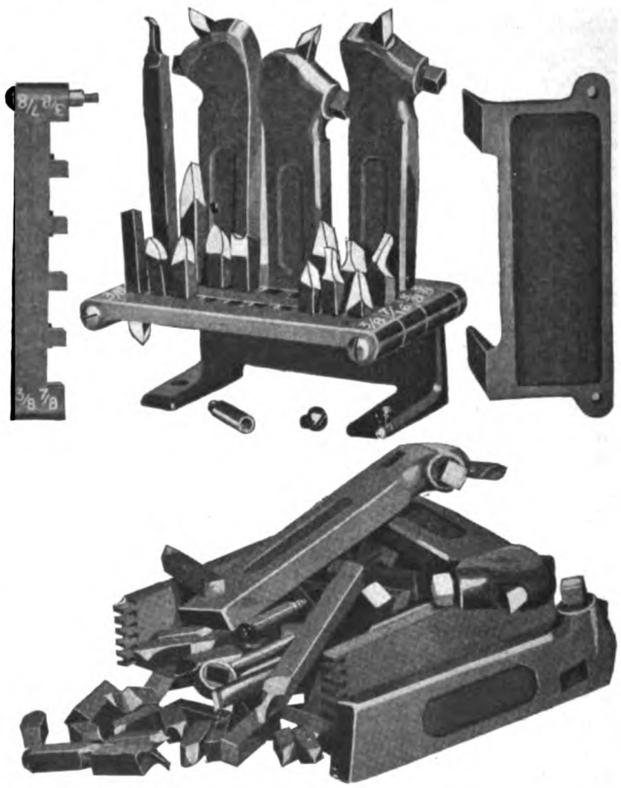
The direct current motors used in these hoists are made by the same company and are especially designed for crane service. All motors are completely enclosed and can be operated outdoors. Direct current motors can be furnished for 110, 220, 500 and 600 volts, while alternating current motors can be furnished for 2 or 3 phase, 25 or 60 cycle, 110 to 550 volts, and are of the slip ring type.

The hoists are fitted with controllers of the drum type, made entirely of non-combustible material. These controllers are provided with a spring return, which automatically shuts off the power when the operating rope is released. The hoists are further provided with current collectors and are wired according to the rules of the National Board of Fire Underwriters.

These hoists are furnished, for use in a monorail system, with or without following cages for the operator. They are also arranged for hook suspension and may be provided with magnets, hooks, etc., for any particular purposes.

A Convenient Tool Rack

A tool rack, providing a place convenient for the tools, that it is made to hold and that automatically arranges the tools as to size when they are put into the rack, is being manufactured by C. H. Driver, Racine, Wis. The



rack is made for the purpose of holding tools for lathes, planers, shapers and automatic machines, also for holding drills, reamers, taps and mandrels, most of which are used in boiler and machine shops.

The rack is made up in sections affording an arrange-

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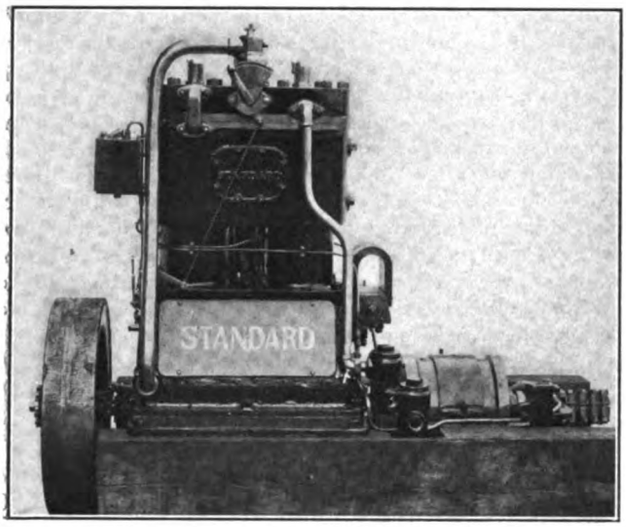
ment by which racks can be made up to hold any desired shape or size of tools or holders and to hold as many of the different tools as are required for each machine that is to be equipped with them. Each section is made so that it will hold only the size of tools that it is made for, so that larger tools will not fit in the rack and smaller tools will fall through. In this way the tools are kept conveniently and systematically and are automatically arranged according to size. The racks can be fastened on the side wall, posts, tool boards or any convenient place on the machines that are to be equipped with them. This not only furnishes a means of keeping tools, etc., within easy reach and in a compact form, but it greatly reduces the chance of tools being lost and finding their way to the scrap heap.

Standard Kerosene (Paraffin) Engine

One of the principal drawbacks to the use of the Diesel or other types of heavy-oil engines for small powers is the high first cost. In small boats where less than 300 horsepower is used, only in a few cases are the engines in operation enough hours in the course of a year to make a saving in fuel which would offset the increased



interest on the first cost of the investment, the depreciation, etc., of the expensive heavy oil engines. With this belief in mind, the Standard Motor Construction Company, Jersey City, N. J., has developed an oil engine which can run successfully on kerosene (paraffin), but which, at the same time, has incorporated in it most of the features found in the Standard gasolene (petrol) engine. These features include low fuel consumption, low first cost and flexibility. The basic principles of design and construction which have proved successful in the Standard gasolene (petrol) engine are maintained in the Standard oil engine. The regular table of weights, dimensions and sizes covering the Standard gasolene (petrol) engines can be used on all sizes for the Standard oil engine, as they are primarily the same. The revolutions are the same and the same horsepower is obtained for the same revolutions. No hot bulbs are required and the engine may be started on gasolene (petrol) or with a small torch or electric mat. Only a few seconds' time is required when starting to get enough heat in the engine for operation on kerosene (paraffin). The ignition in the oil engine is the same low tension make-and-brake as in the Standard gasolene (petrol) engine. The two-cylinder engine shown in the illustration is rated at 16 to 18 horsepower, the diameter of the cylinders being 6 inches and the stroke 8 inches.

Rotary Air Compressor

An air-cooled, rotary air compressor that can be directly connected to a high-speed electric motor or driven by a belt, and that is claimed to give a large delivery with a low power consumption, is being manufactured by the Wernicke-Hatcher Pump Company, Grand Rapids, Mich.

The pump consists essentially of a rotor and a rotor case, both of which revolve on eccentric centers; a shaft with intake and discharge ports, the rotor being keyed

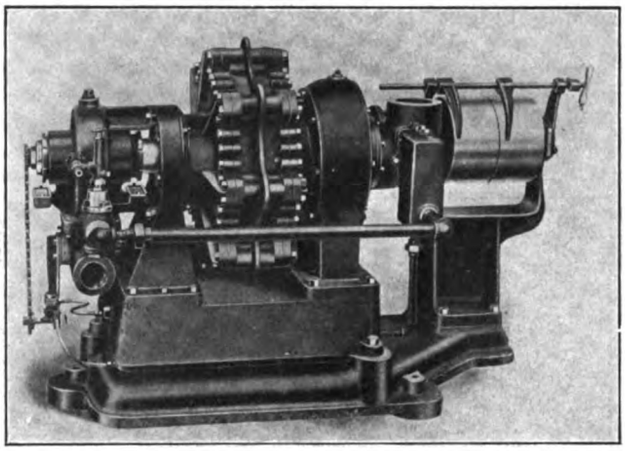


Fig. 1.—Belt-Driven Rotary Air Compressor

to the shaft; and bearings for the shaft and casing. The space between the rotor and casing is divided into a number of pockets by means of sliding vanes which pivot on shoes fitted to the face of the rotor. Each pocket is provided with an intake and a discharge valve connecting through suitable passages with the intake and discharge passages in the hollow rotor shaft.

Rotor and rotor case both revolve, one within the other, in the same direction and at the same number of revo-

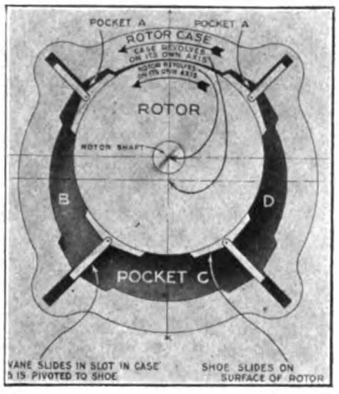


Fig. 2.—Cross Section of Rotary Compressor

lutions per minute and each on its own axis or centerline. Since the rotor and casing are eccentric, so that they practically touch at one point, it is easily seen that during one-half of a revolution the pockets are expanding and drawing in air, and during the other half revolution the pockets are contracting and compressing the air.

It is claimed that the cooling for this pump is very effective, since the heat of compression is practically eliminated at its source by radiation due to the very large proportion of radiating surface to air contained. Also the area of cooling surface is constant and the effective part

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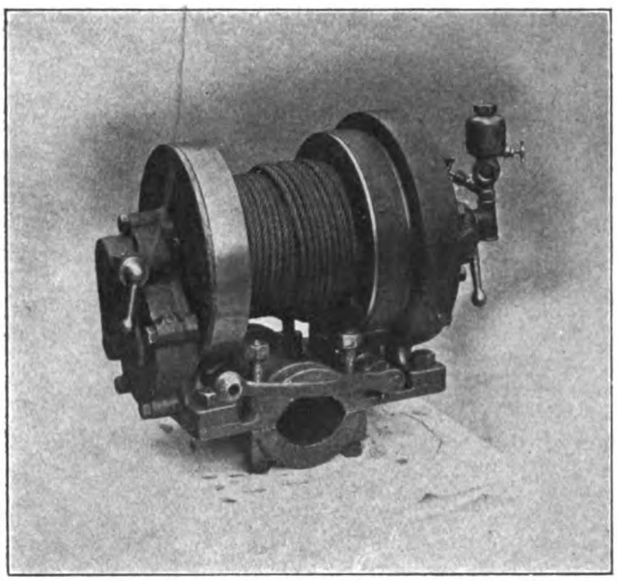
of it, the outer, exposed surface of the rotor, is cooled by revolving at high speed.

Many important advantages are claimed for this new principle in air compressors, such as smooth running, even wear, cool operation, large deliveries of air at high-pressures, low power consumption running and starting, light and compact, easily installed, choice of drive, efficient at all speeds up to maximum, and steady flow of air without pulsations.

The "Little Tugger" Hoist

A new type of hoist intended for light lifting work, having a capacity up to half a ton, has recently been placed on the market by the Ingersoll-Rand Company, New York. Due to its light weight, which is under 300



pounds complete, it is particularly suitable for use as a portable hoist for mines, for contract work, for manufacturing plants, for power houses and in railroad shops and shipyards, where it can be put to innumerable uses.

The main base of the hoist is arranged so that it can be bolted to a timber, and by means of a cap which comes with the hoist it can be clamped to a circular member, as a column or arm, shaft, bar or pipe. The adjustment can be made quickly. The dimensions of the hoist are 21¼ inches by 16½ inches, and the height is 20⅞ inches. The drum is 6 inches in diameter, with a space of 7 inches between flanges. This will accommodate a length of 700 feet of ¼-inch rope or 450 feet of 5/16-inch rope. The capacity is 1,000 pounds at a rope speed of 85 feet per minute and a pressure of 80 pounds. It operates with either compressed air or steam.

The motor or engine is of the reversible, square-piston type, giving four impulses per revolution of the engine. There are no dead centers and it is claimed that the "Little Tugger" will start in any position. The drum is mounted independent of the engine shaft and is operated through the medium of a clutch and gears. Safety is provided for by a powerful worm-operated band brake lined with "Raybestos."

Referring to the illustration, which shows a front view of the "Little Tugger" hoist, the engine is on the right-hand side, the gear case is on the left-hand side, and between the two are the brake and drum. The lever on the left controls the gears and clutch, the one on the right hand controls the direction of operation, and the bottom lever operates the brake. The speed of hoisting is entirely at the will of the operator. When he releases the throttle it returns automatically to central position, shutting off the power and stopping the hoist. Oftentimes the hoist will be used for haulage purposes, and the release feature enables one man to handle this class of work. He can leave the control lever and carry the rope to the car. Hoists without this feature require two men, inasmuch as the rope has to be released under power.

There are no moving parts exposed on the "Little Tugger" except the drum, all gears and shafts being covered. This is an especially desirable feature for operation in confined quarters where the light is none too good and where there is constant danger of workmen's clothes or bodies getting caught in machinery.

Shallow Water Boats

The Shallow Water Boat Company, 55 Liberty street, New York, has brought out a new system of tunnel construction for use in the operation of tunnel-stern, shallow-draft boats. The tunnel is constructed to suit the size of the propeller so that the propeller can be placed entirely above the bottom of the boat inside the tunnel. To the top of the tunnel is secured a vertical pipe of any convenient size, which is connected to an air pump by means of which the air can be exhausted from the pipe. This keeps the tunnel and pipe constantly filled with water, regardless of the actual draft of the boat, so that the propeller is entirely submerged as long as a vacuum is maintained in the stand pipe. This system is claimed to be efficient and economical in operation and to be applicable to any boat of the shallow draft type.

Personal

Harry Gregg, of Buffalo, N. Y., has been appointed chief engineer of the steamer *Harvester*, succeeding J. M. Chapman.

Thomas J. O'Connor, formerly chief engineer of the steamship *Lackawanna*, has been appointed engineer on the municipal fire steamers of the city of Buffalo.

Theodore Silas has been appointed assistant engineer of the steamer *Frederic Du Barry*, of the Chesapeake & Potomac Steamboat Company, of Washington, D. C.

Cyrus M. Yarter, of Albany, N. Y., has been appointed chief engineer of the steamer *Ashford*. Mr. Yarter was formerly chief engineer of the steamer *Herbert J. Dolan*.

Capt. George E. Burd, U. S. N., who has been engineer officer of the New York Navy Yard, Brooklyn, N. Y., for four years, has been appointed industrial manager of the Yard.

Robert A. Mosely, of Albany, N. Y., formerly in the United States Revenue Cutter Service, has accepted a position with the Seeley Engineering Company, of New York City.

William J. Garrett has resigned as first assistant engineer of the Anchor Line steamer *Muncy* to accept a position as engineer in the new Masten Park High School at Buffalo, N. Y.

John F. Jackson, chief engineer of the steamship *Bear*, of the San Francisco & Portland Steamship Company,

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and senior officer of the fleet, has been given one month's leave of absence.

Robert Paul, chief engineer of the steamship *Mongolia*, of the Pacific Mail Steamship Company, has returned to duty after a vacation of two months spent at his home in Brooklyn, N. Y.

William L. Bunker, formerly chief engineer of the steamship *Manchuria*, of the Pacific Mail Steamship Company, has accepted a position with the Great Northern Steamship Company.

Robert Keefe, formerly first assistant engineer of the Anchor Line passenger steamer *Octarara*, has been promoted to the position of chief engineer of the steamer *Susquehanna* of the same line.

George R. Smith, of Norfolk, Va., has been appointed chief engineer of the steamer *St. Johns*, of the Chesapeake & Potomac Steamboat Company, Washington, D. C., taking the place of E. Fitzgerald, resigned.

Ramsay Farley, formerly second assistant engineer of the British steamer *Persia*, of the Pacific Mail Steamship Company, has been appointed first assistant engineer of the steamship *Peru* of the same company.

Robert E. Mullane, formerly treasurer of the D. T. Williams Valve Company, Cincinnati, Ohio, has been elected president of the company, succeeding Mr. D. T. Williams, whose resignation took effect September 21.

Arthur Robinson, formerly assistant engineer of the steamer *St. Johns*, has been transferred to the steamer *Wakefield*, of the Chesapeake & Potomac Steamboat Company, and promoted to the position of chief engineer.

Louis L. Bernier, manager of the Multicoil Company, 78 Broad street, New York City, has been appointed New York agent for the Kingsford Foundry & Machine Works, Oswego, N. Y., builders of marine and stationary boilers.

John B. Morris, first assistant engineer of the steamship *Columbian*, of the American-Hawaiian Steamship Company, has resigned to accepted a position on one of the new turbine boats of the Great Northern Company, which will operate on the Pacific coast.

H. V. Barbarie has resumed his position as chief engineer of the steamship *China*, of the Pacific Mail Steamship Company, while Max Oettle, who acted in that capacity on the last voyage of the vessel, has been transferred to shore duty with Superintendent Chisholm.

Charles J. Koen, for several years chief engineer of the Yukon River boats of the Northern Navigation Company, has been appointed postmaster at St. Michael, Alaska. Mr. Koen has also been appointed United States Commissioner for the Second Judicial District of Alaska.

Arthur Curtis, formerly employed on the tug *Joseph Arnold*, of the Albany Towing Company, Albany, N. Y., has been transferred to the position of first assistant engineer of the steamer *George N. Southwick*. The tug *Joseph Arnold* has been laid up at Schodack, N. Y., for the season.

Andrew Fletcher, president of the W. & A. Fletcher Company, Hoboken, N. J., ship and engine builders, has been elected a director of the American Locomotive Company to fill the vacancy caused by the resignation of Charles M. Schwab, president of the Bethlehem Steel Company.

Samuel Wheatland, of Chicago, Ill., is chief engineer of the lake tug *M. A. Knapp*, of Duluth, Minn. The tug was pontooned and brought through the Erie Canal to work on the Hudson River for the Great Lakes Dredge & Dock Company. Charles Hunt, of Rensselaer, N. Y., is first assistant engineer of the tug.

William Hyde, who has been chief engineer of the tug *W. B. McCollough* through the summer, has accepted a position in the Cornell shops at Rondout, N. Y., as the tug has been laid up in Rondout for the season. Captain Charles Scott, who had charge of the *W. B. McCollough*, will act as auxiliary captain of the Albany Towing Company.

George C. Shepard, formerly chief engineer of the American-Hawaiian Steamship Company, New York, has been appointed general manager of the Poole Engineering & Machine Company, Baltimore, Md. Before his association with the American-Hawaiian Steamship Company, Mr. Shepard was chief engineer of the marine department of the Maryland Steel Company, Sparrows Point, Md.

Charles Buchanan, principal of the chief ship surveyors' staff of Lloyd's Register, London, has been forced on account of his health to give up active service. Mr. Buchanan has been in the service of Lloyds Register for over thirty-four years, twenty-three of which have been spent in the head office in London. For seven years prior to the death a year ago of Dr. Samuel J. P. Tearle, chief ship surveyor of Lloyds, Mr. Buchanan held the position of assistant chief ship surveyor. Mr. Buchanan is a native of Dumbarton and served his apprenticeship in that town. In 1880, when he joined Lloyds Register as a surveyor, he held the position of chief draftsman in the shipyard of Archibald McMillan & Son, Dumbarton. For the first twelve years of his association with Lloyds Register, he represented the society in various districts, including Barrow, Stockton, Middlesbrough, Hartlepool, Sunderland and Newcastle, after which he was transferred to the London office.

Obituary

A. P. Hillman, Joseph Drennon and D. J. Reid, engineers on the steamship *Francis H. Leggett*, lost their lives when that vessel foundered off the coast of Oregon, September 18.

Sir Stephen Furness, Bart., chairman of Messrs. Furness, Withy & Company, was killed instantly on September 6 as a result of a fall from the fifth floor of a hotel at Broadstairs, where he was staying. Sir Stephen was forty-two years old.

Andrew J. Cohen, first vice-president of the Merchant & Evans Company, Philadelphia, died from an attack of heart disease October 11, at the Hotel Knickerbocker, New York City. Mr. Cohen was chairman of the metal committee of the National Hardware Association.

John Clarke, Sr., principal of the North-East Coast Engineering Works, Hull, died July 20 at the age of 44. Mr. Clarke served his apprenticeship in the engineering trade with Messrs. Joicey, of Forthbank, Newcastle. His first experience as a sea-going engineer was with the Wilson Line. Later he served on the East Indian Mutual Line of steamers. Upon leaving sea life he became manager of the Northern Marine Engineering Works, South Shields, and was later associated with the Hull Central Dry Docks, Ltd., and the R. M. S. Packet Company, serving as superintendent engineer of the latter until he opened the North-East Coast Engineering Works.

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SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

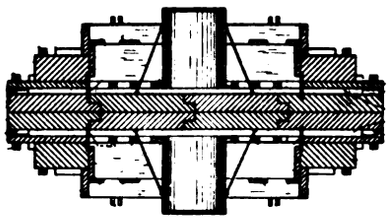
American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

1,104,089. AUTOMATIC SAFETY LAUNCHING DEVICE FOR LIFE-BOATS. CHARLES W. WEILAND, OF BROOKLYN, N. Y.

Claim 1.—The combination with the hull of a life-boat adapted to be launched from a ship, of a plurality of strengthening bands extending substantially from the gunwale to the keel of said life-boat, brackets mounted on said bands approximately at the bilge of said life-boat, and adapted together with said bands to distribute shocks over a large area of the said hull, and wheels mounted in said brackets and adapted to roll on the side of said ship as the said life-boat is raised or lowered, substantially as described. Four claims.

1,105,976. LIFE-SAVING RAFT. WILLIAM JACOB, OF SAN LEANDRO, CAL.

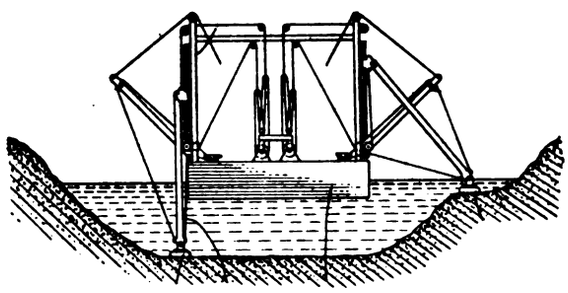
Claim 5.—A raft comprising a central platform of heavy wooden beams, strips of wood on each side of said platform, spaced apart to furnish water outlets, non-return valves in said water outlets, heavy



beams over said strips, cabin walls secured to said beams, ropes secured to the raft and floats secured to the ends of the ropes. Five claims.

1,108,001. DIGGING AND DREDGING MACHINERY. WILLIAM J. QUIMBY, OF NEW YORK, N. Y., ASSIGNOR TO THE HAYWARD COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

Claim 1.—In a retaining mechanism for dredges, and the like, the combination with an upwardly extending guide, of a swinging spud, means for pivotally and slidably connecting the inner end portion of



said spud to said guide whereby the spud may be raised or lowered relative to the guide and it is adapted to be pivotally shifted in an inward or outward direction relative thereto, a spud foot loosely connected to the outer portion of said spud, a hoisting cable, and a pulling down cable, said cables being attached to the spud adjacent to the pivotal and slidable connection between the spud and the guide. Seventeen claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

12,088/1913. "IMPROVEMENTS IN GRAPPLING DEVICES FOR USE IN CONNECTION WITH THE RAISING OF SUNKEN VESSELS." L. VALEROY, OF BIBERIST.

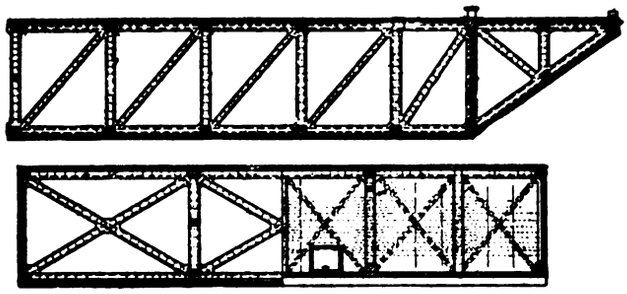
Relates to grappling devices for use in connection with the raising of vessels by the method in which a float released from the sunken vessel raises a rope, down which a lifting chain or the like, having a grappling device, is slid from a salvage vessel, which grappling device automatically couples itself to a union cone secured to the sunken vessel. In the drawing the grappling irons are shown being lowered down the guide rope; the ring guiding the irons onto the cone, which is secured to the vessel to be raised.

24,934/1913. NEW OR IMPROVED MEANS FOR TRANSFERRING LIQUIDS TO OR FROM SHIPS OR VESSELS. T. FAIRFIELD, OF 20 GLOUCESTER CRESCENT, LONDON.

Any desired length of ordinary or armored hose has a number of ropes of steel or other suitable material arranged in a longitudinal direction around its periphery, the size and strength of such ropes being varied according to the towing or pulling strain which they are intended to bear. A rope is connected to and bound round ropes for the purpose of keeping the latter in position on the hose and also for resisting the interior pressure on the hose when the liquid is being pumped through. The ropes are connected at each of their ends to a coupling device consisting of a tube of metal provided with a flanged end, these ends are passed through holes in the tube and then spliced. A tube with a flanged end passes through coupling and extends for a certain distance into hose. To allow for any stretching of ropes and consequent movement of hose and tube, the latter projects beyond the flange of the coupling device.

19,077/1913. IMPROVEMENTS IN THE CONSTRUCTION OF BARGES, SCOWS, PONTOONS OR OTHER VESSELS OF REINFORCED CONCRETE. N. K. FOUGNER, MANILA, PHILIPPINE ISLANDS.

Claim.—The invention relates to improvements in the construction of barges, scows, pontoons or other vessels of reinforced concrete, and,



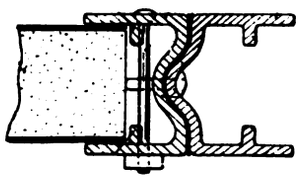
more particularly to the method of construction employed in specifications Nos. 29,938 and 29,939 of 1912. It is not intended to lay claim to any special type of steel reinforcement, but the essence of the invention is the scientifically designed arrangement of the steel in the various parts and portions of the vessels, and the shape and arrangement of the different detail members of the craft. The drawing indicates a part vertical transverse section and a part vertical longitudinal section of a scow.

14,192/1913. NAUTICAL INSTRUMENT. KELVIN & JAMES WHITE, LTD., OF 16, 18 AND 20 CAMBRIDGE STREET, GLASGOW, AND M. B. FIELD.

An instrument primarily for use in locating the position of a ship at any time relatively to a chart. It consists of a transparent sheet so adapted that when superimposed upon an ordinary chart the chart may be easily read through the instrument. Marked on the sheet is a graduated circle. From the center of the circle are drawn two lines perpendicular to one another. Parallel to one of these lines is drawn a series of lines uniformly spaced apart. These parallel lines are intersected by lines drawn from the center of the circle and inclined to the parallel lines at angles corresponding to the angular displacement from the lubber line of the markings on the compass bowl. The points of intersection of one of the parallel lines with the inclined lines may thus be taken to represent stations uniformly spaced apart. The navigator, taking the bearings of an object from stations on the course line, the observation angles of which are represented by two angles of the series above referred to, and measuring by means of the log the distance between the two stations, can estimate the distance at which the ship will pass the object sighted.

11,987/1913. PORTABLE WALL SECTION PARTICULARLY APPLICABLE FOR USE IN THE CONSTRUCTION OF SHIP BULKHEADS. H. PLOGER AND ANOTHER, BERLIN, GERMANY.

Relates to paneling for use in the manufacture of ships' bulkheads, each section embodies a rigid open frame formed of profiled metal bars, which frame forms a receiver for the material, which may have both fire and sound-resisting qualities. The outline of the lateral frame end bars



are of the shape shown or of any similar shape, comprising a projection and a depression so that the faces of two adjoining end bars will interengage in the manner shown. The adjoining end bars are connected by means of flat iron pieces and are retained externally by means of bolts.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., of INTERNATIONAL MARINE ENGINEERING, published monthly at New York, N. Y., required by the Act of August 24, 1912.

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Owners—H. L. Aldrich, 17 Battery Place, New York; M. G. Aldrich, 17 Battery Place, New York.

Known bondholders, mortgagees, and other security holders, holding 1 percent or more of total amount of bonds, mortgages or other securities: A. I. Aldrich, Manville, R. I.; J. W. Reno, 684 St. Nicholas Ave., New York; George Slate, Summit, N. J.; E. L. Sumner, Flushing, N. Y.; H. H. Brown, 17 Battery Place, New York.

ALDRICH PUBLISHING CO.,
H. L. ALDRICH, President and Treasurer.

Sworn to and subscribed before me this 14th day of September, 1914.

OSCAR M. PICKRUHL.

(My commission expires March 30, 1915.)

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